UK CLIMATE PROJECTIONS

Validation of Weather Generator outputs

Updated March 2011

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Validation of the Weather Generator outputs

The purpose of this note is to provide additional Weather Generator (WG) validation plots to supplement those found in Chapters 1 and 3 of the UKCP09 Weather Generator Report. In this note a further nine stations spread over the UK (see Figure 1 and Table 1) are included to give a variety of climate types. All plots are produced using the same methodology described in Chapters 1 and 3. Additional plots of extreme indices are also included here, plotted from statistics produced by the STARDEX indices software – see Table 2 for definitions.

In the UKCP09 Weather Generator Report (Chapter 1) the WGs ability to reproduce observed data (Ringway) is assessed by using half monthly and seasonal plots. Here, we provide additional plots (Figures 2–11) of the WG output variables compared to the observed data the WG was calibrated on. The statistics for the plots were derived by fitting the WG to each of the observed station data (1961–1990) and generating 100 runs each of 30 year length. The means and standard deviations for the 100 runs are then plotted against the observed mean (Figures a and b) together with the extreme indices (Figure c).

The UKCP09 Weather Generator Report (Chapter 3) provides some evidence of the capability of the WG to reproduce the daily weather variability simulated directly by the Regional Climate Model (RCM). In that report, this was done by showing plots for the RCM 25 x 25 km grid box that includes Heathrow Airport for the 2080s. The WG simulations are generated using the procedure described in that chapter. In these plots (Figures 12–21) are shown the means and ranges of the 100 generated sequences, together with the crosses (for the member of the 11 RCMs with the standard set of RCM parameter values – see Murphy *et al.* 2009[1]), which is the direct RCM average for the future 30-year period centred on the 2080s (Figures a and b). Also shown in these figures are the differences (in other words the climate change component) compared to the RCM control run (Figures c and d). Additional plots of extreme indices are also included here (Figures e and f).

Conclusion: For almost all variables and half months, the direct RCM future values (the crosses) are within the ranges generated by the WG.

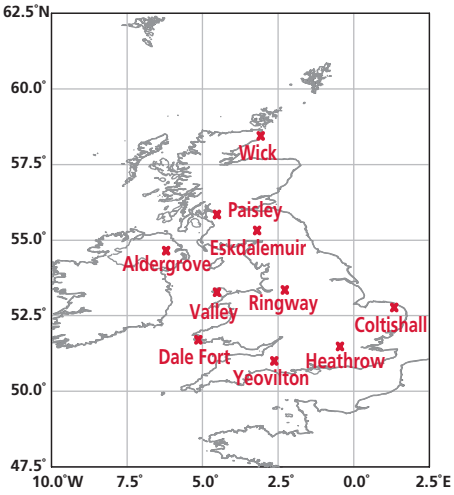

Figure 1: Distribution of the 10 locations.

1 Murphy, J.M., Sexton, D.M.H., Jenkins, G.J., Boorman, P.M., Booth, B.B.B., Brown, C.C., Clark, R.T., Collins, M., Harris, G.R., Kendon, E.J., Betts, R.A., Brown, S.J., Howard, T. P., Humphrey, K. A., McCarthy, M. P., McDonald, R. E., Stephens, A., Wallace, C., Warren, R., Wilby, R., Wood, R. A. (2009), UK Climate Projections Science Report: Climate change projections. Met Office Hadley Centre, Exeter.

In order to make a valid comparison with the RCM, this latter set of plots (Figures 12–21) was produced by calibrating the WG on the RCM control period (1961–1990). At this point it is important to realise that for UKCP09 the WG has been fitted using observational data (see UKCP09 Weather Generator Report), then perturbed (with the Change Factors) according to the procedure described in Chapter 3.

The WG outputs reflect local topographic and coastal influences to the extent that such influences are captured by the observational data at the 5 km resolution. Assuming that these influences will remain unchanged in the future, their affects are incorporated into the future generated sequences. As such, the outputs from the WG better reflect these local influences on the daily time series than can be simulated by the RCM.

Table 1: Coordinates for the 10 stations

Station	Elevation (m)	Latitude	Longitude
Aldergrove	68	54.65	–6.22
Coltishall	17	52.77	1.35
Dale Fort	33	51.70	–5.15
Eskdalemuir	242	55.32	–3.20
Heathrow	25	51.48	–0.45
Paisley	32	55.85	–4.43
Ringway	69	53.35	–2.28
Valley	10	53.25	–4.53
Wick	36	58.45	–3.08
Yeovilton	20	51.00	–2.63

Table 2: Definition of the extreme indices

Description of STARDEX indices	Definition
Fraction of total precipitation from intense events	Fraction of total precipitation above the annual 95th percentile value
Maximum number of consecutive dry days	Maximum number of consecutive dry days
% of hot days	% of days when maximum temperature is greater than the 90th percentile value
Heatwave duration	Cumulative count of number of consecutive days when maximum temperature exceeds the 90th percentile value for more than 5 days (NB the first 5 days are not counted in the index)
% of Warm nights	% of days when minimum temperature is greater than the 90th percentile value
% of Cold nights	% of days when minimum temperature is less than the 10th percentile value

Weather Generator calibration plots

The performance of the Weather Generator in reproducing observed data (1961–1990) is assessed by using half monthly and seasonal plots of the weather variables. This was carried out for 10 stations spread over the UK (see Figure 1) to give a variety of climate types. This was carried out by fitting the Weather Generator to each of the observed station data and generating 100 runs each of 30 year length. The means and standard deviations for the 100 runs are then plotted against the observed mean.

Aldergrove

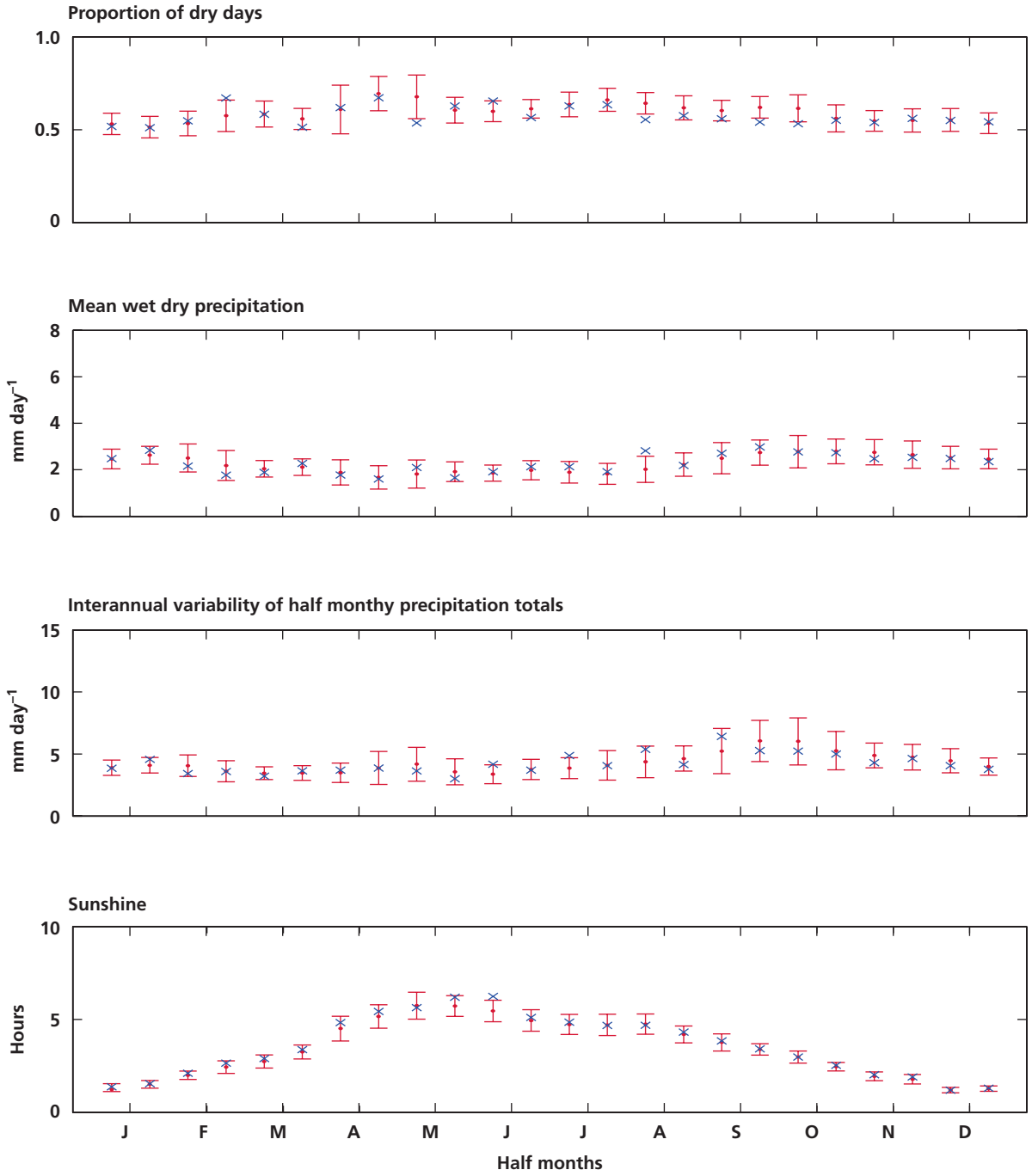

Figure 2a. Validation plot for calibration on Aldergrove observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Aldergrove

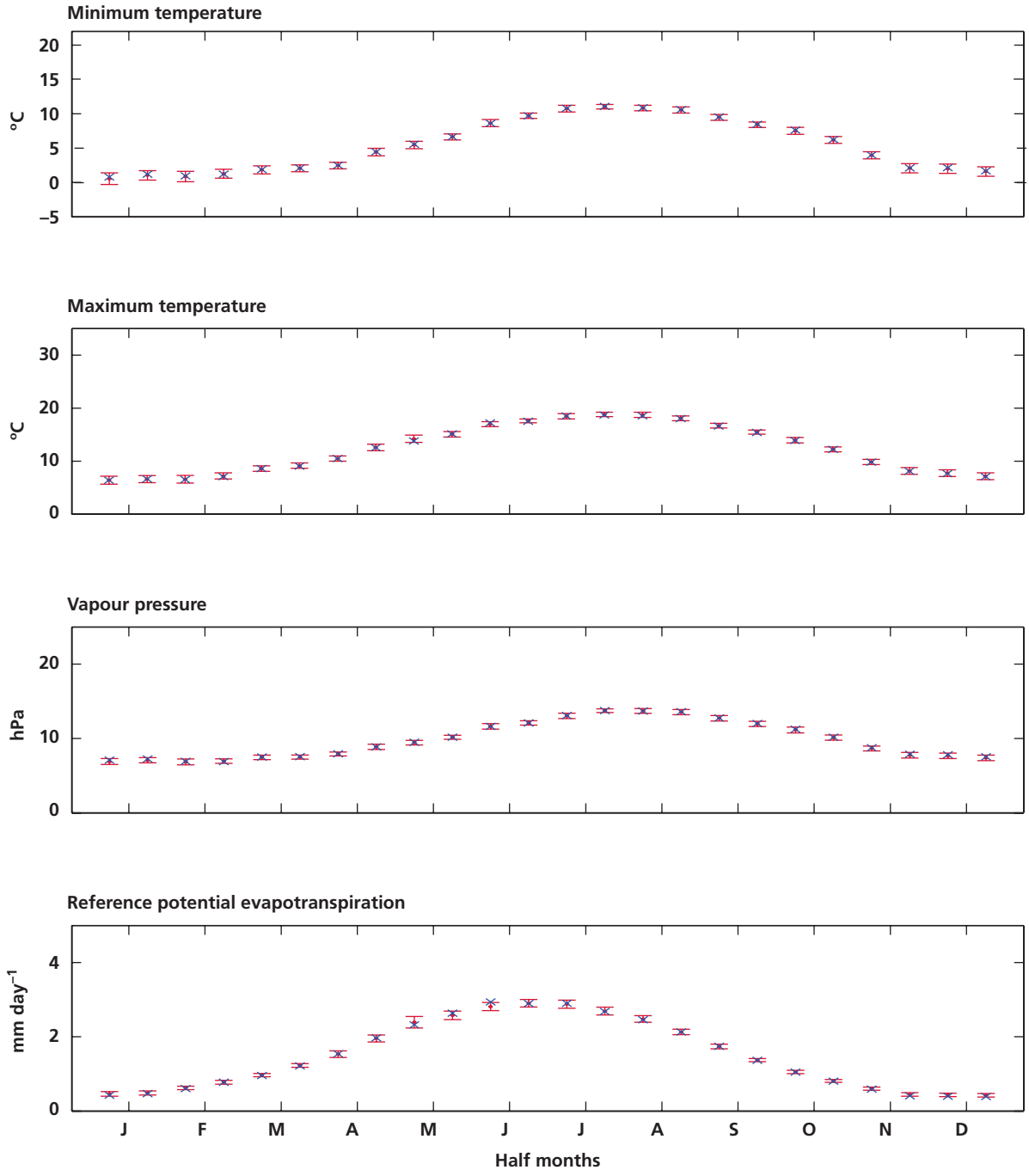

Figure 2b. Validation plot for calibration on Aldergrove observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Aldergrove

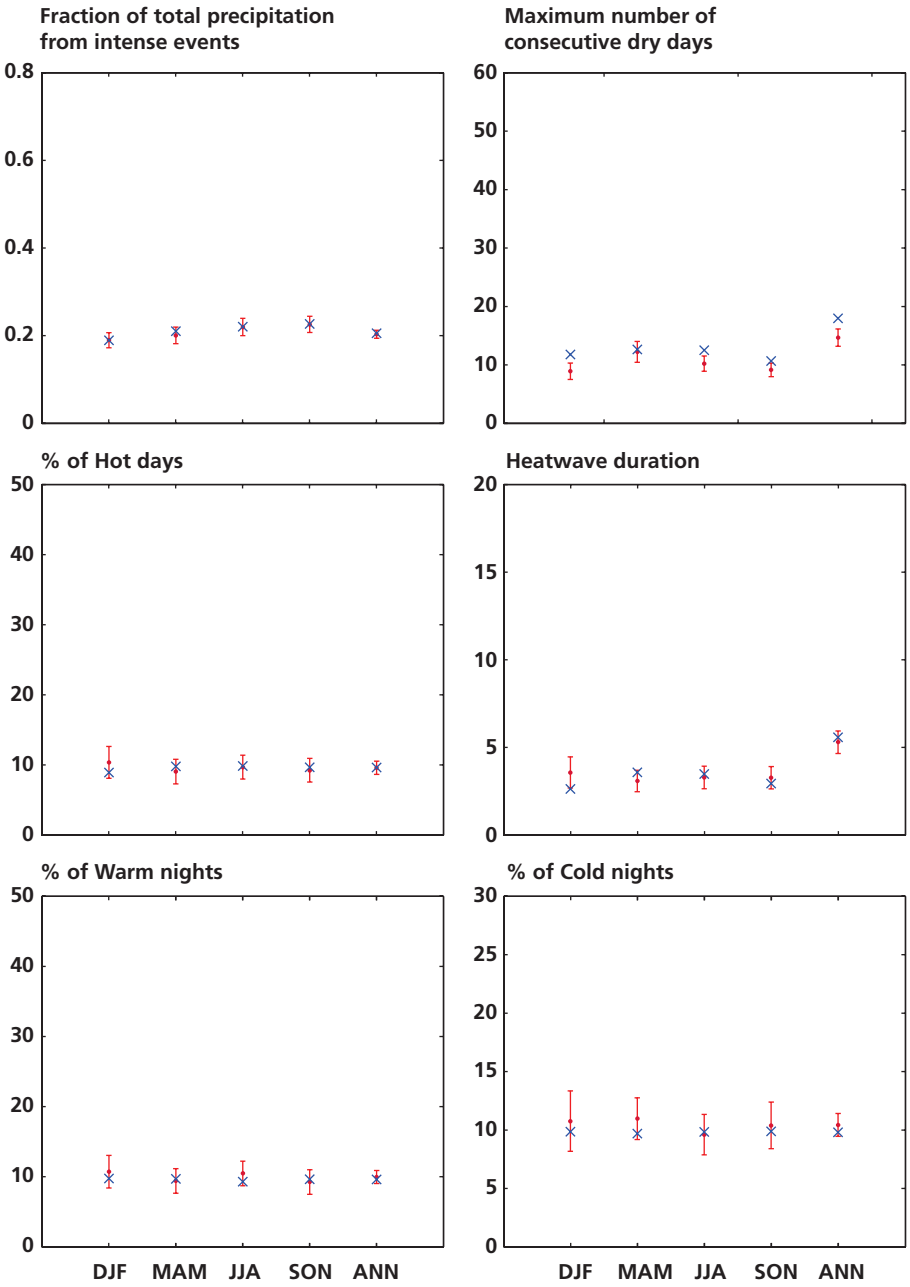

Figure 2c. Validation plot for calibration on Aldergrove observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Coltishall

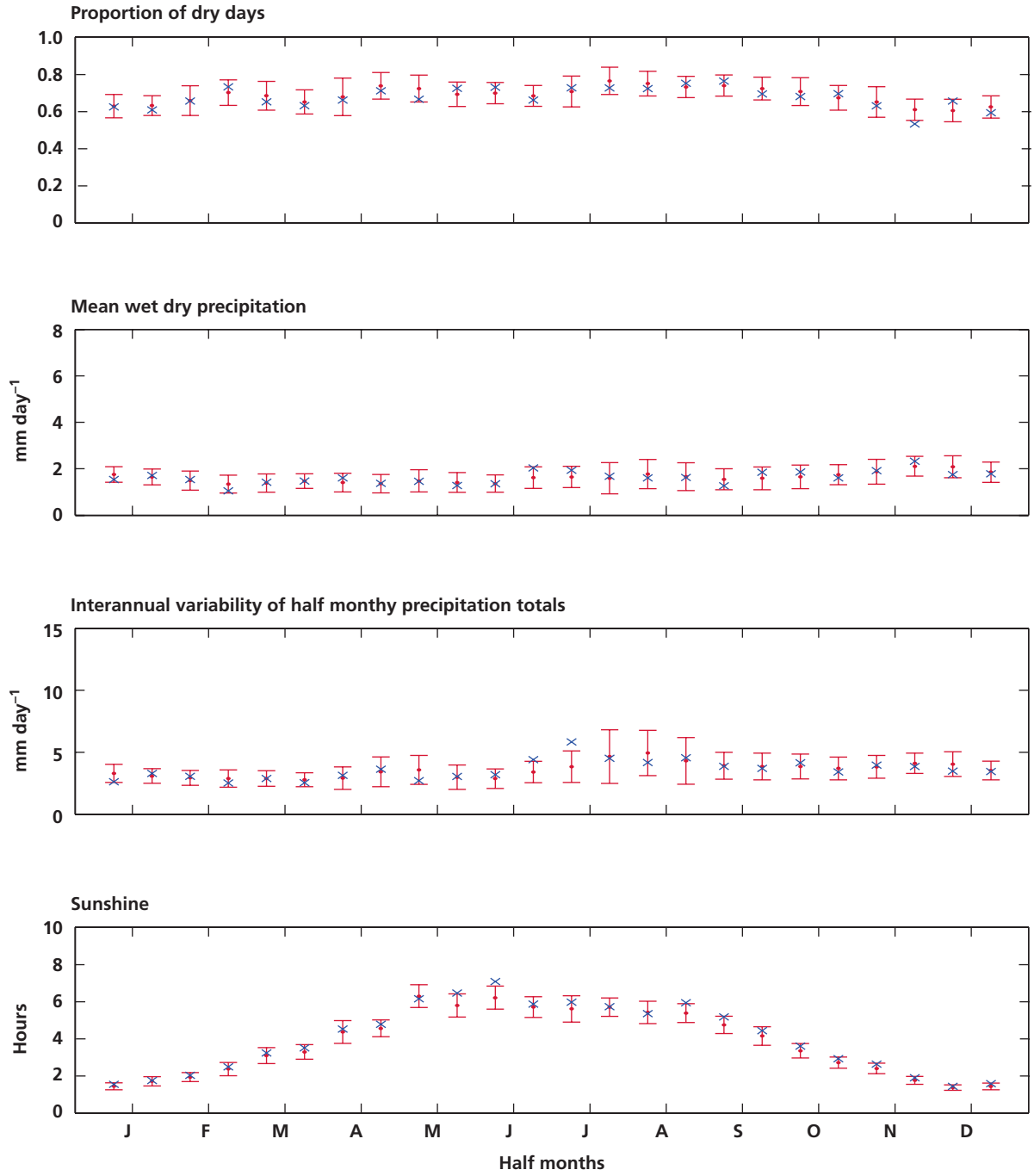

Figure 3a. Validation plot for calibration on Coltishall observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Coltishall

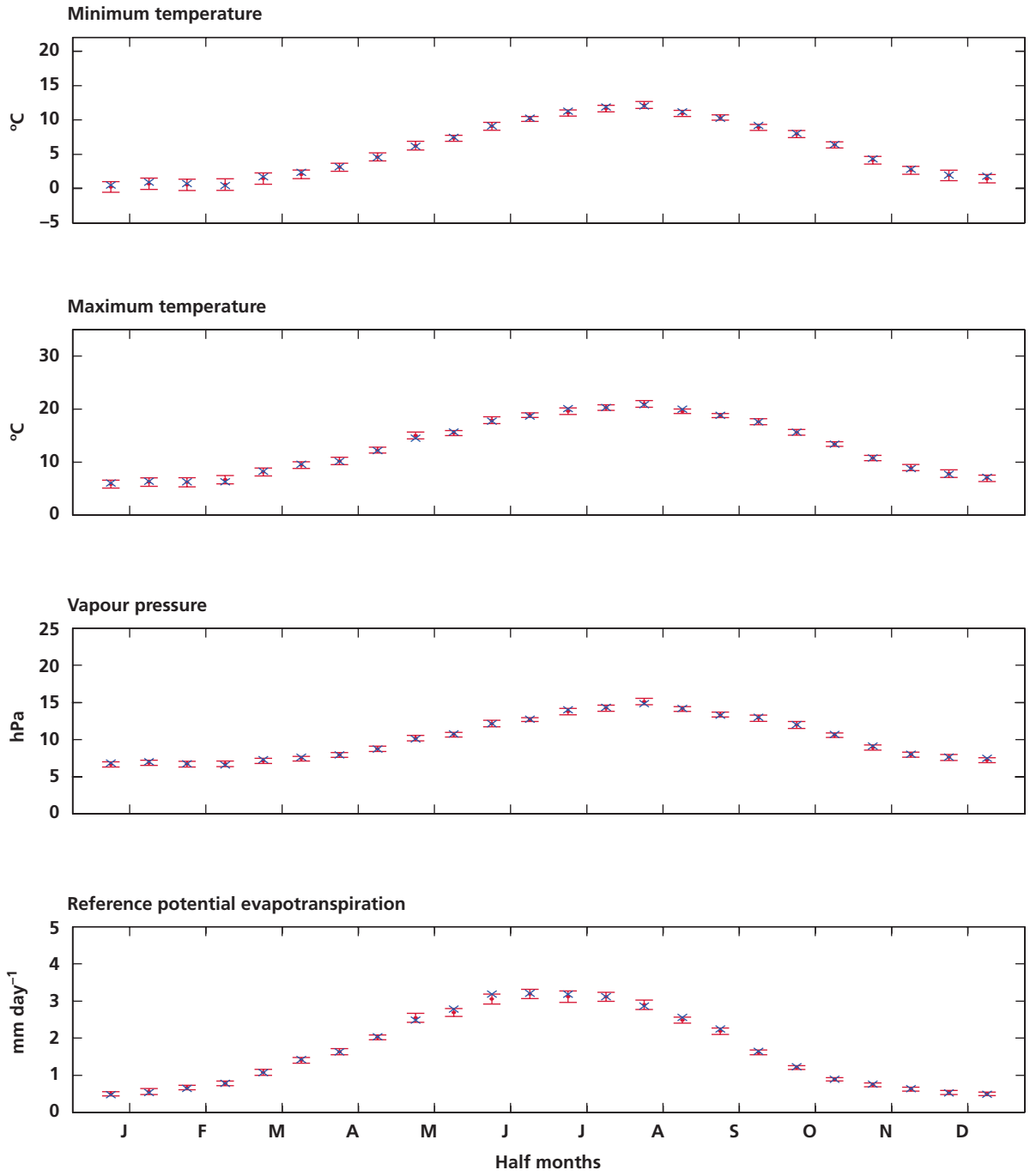

Figure 3b. Validation plot for calibration on Coltishall observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Coltishall

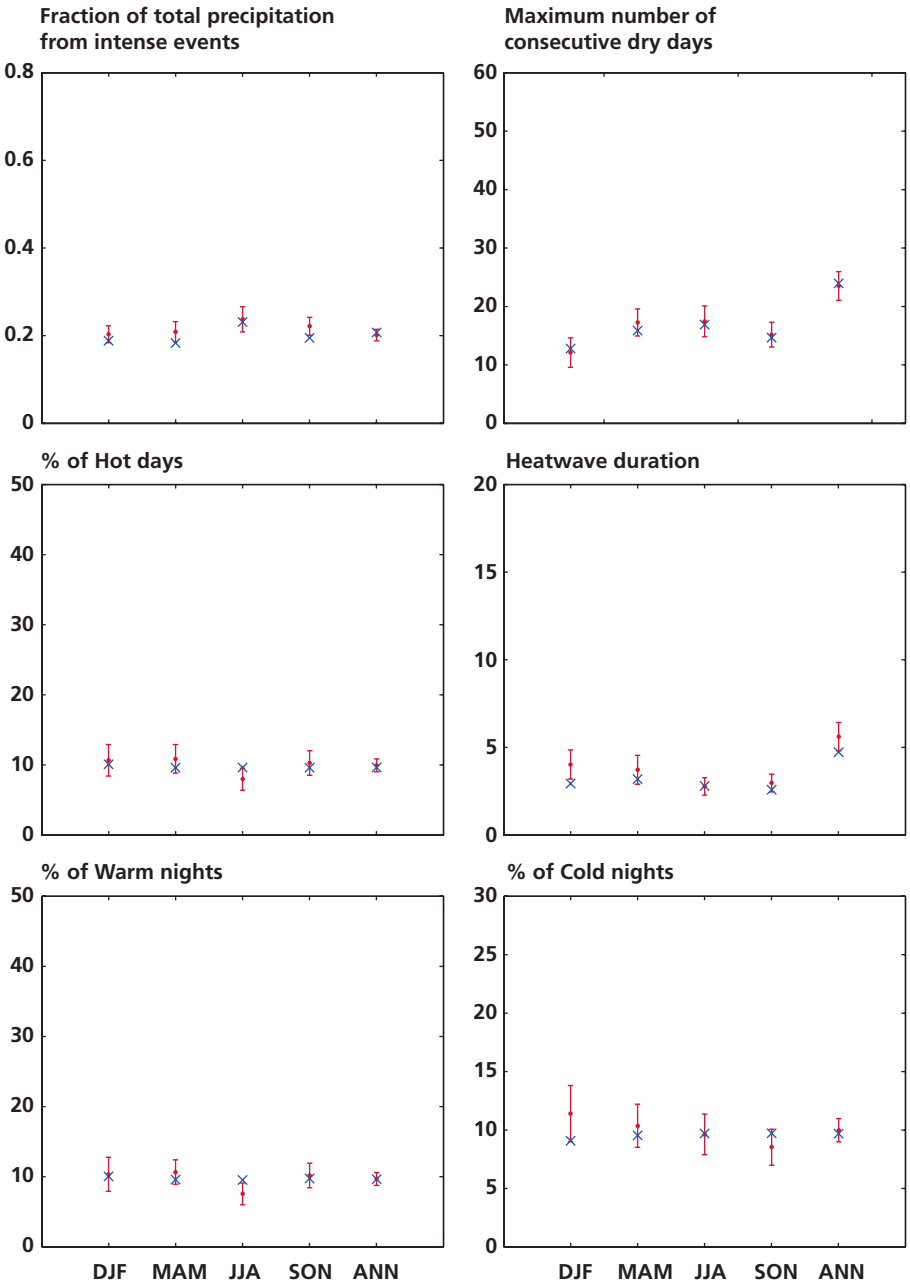

Figure 3c. Validation plot for calibration on Coltishall observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Dale Fort

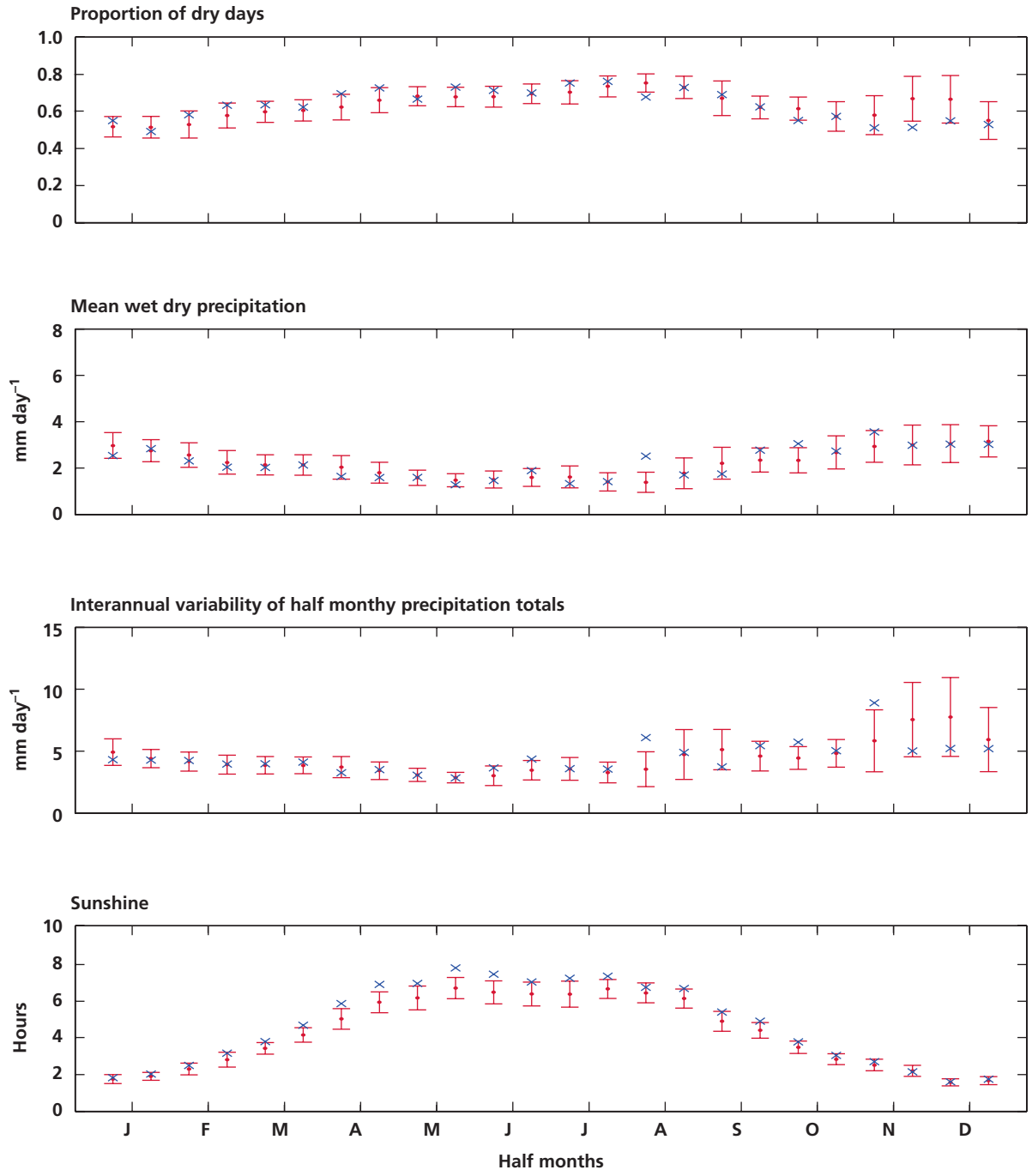

Figure 4a. Validation plot for calibration on Dale Fort observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Dale Fort

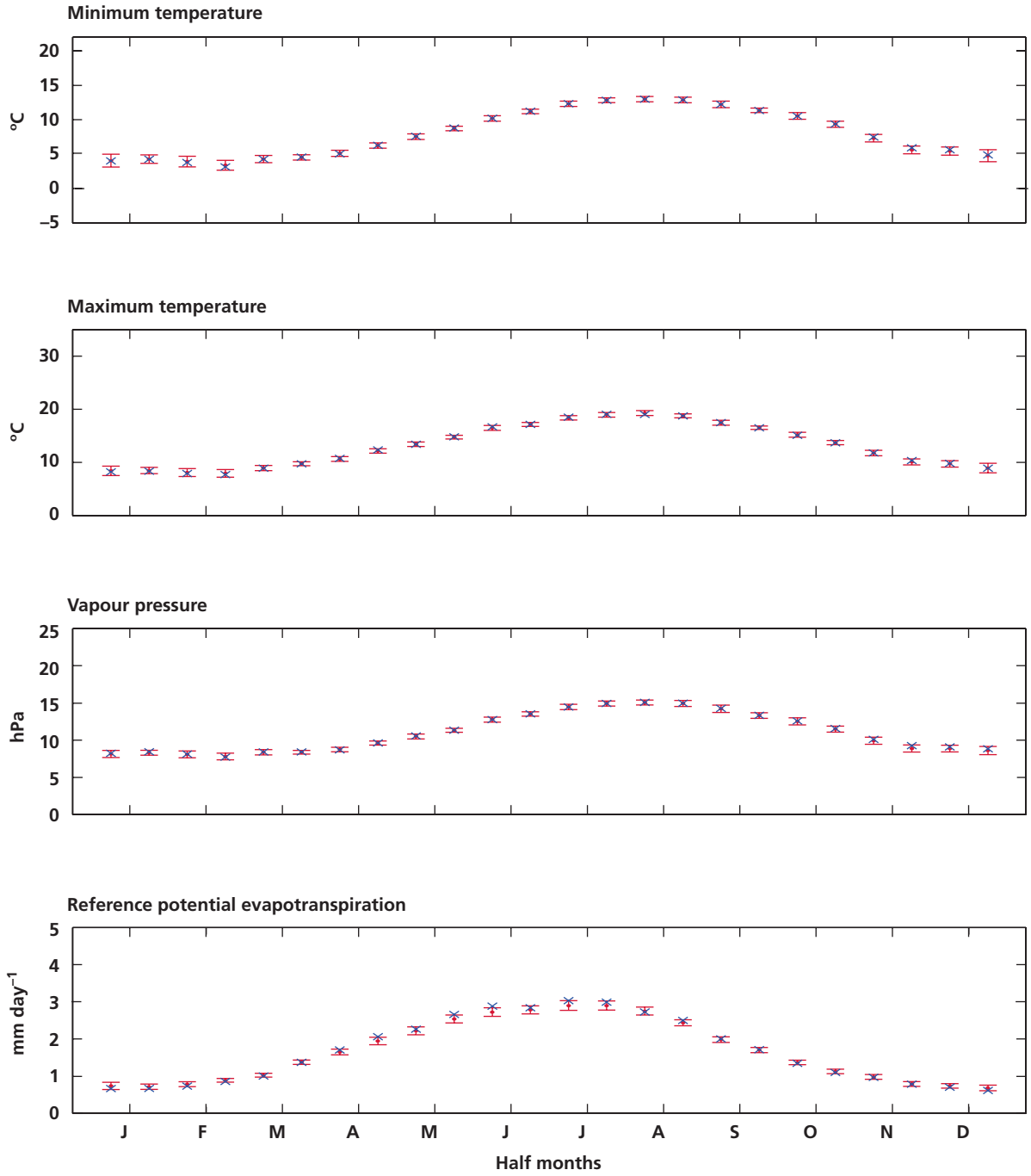

Figure 4b. Validation plot for calibration on Dale Fort observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Dale Fort

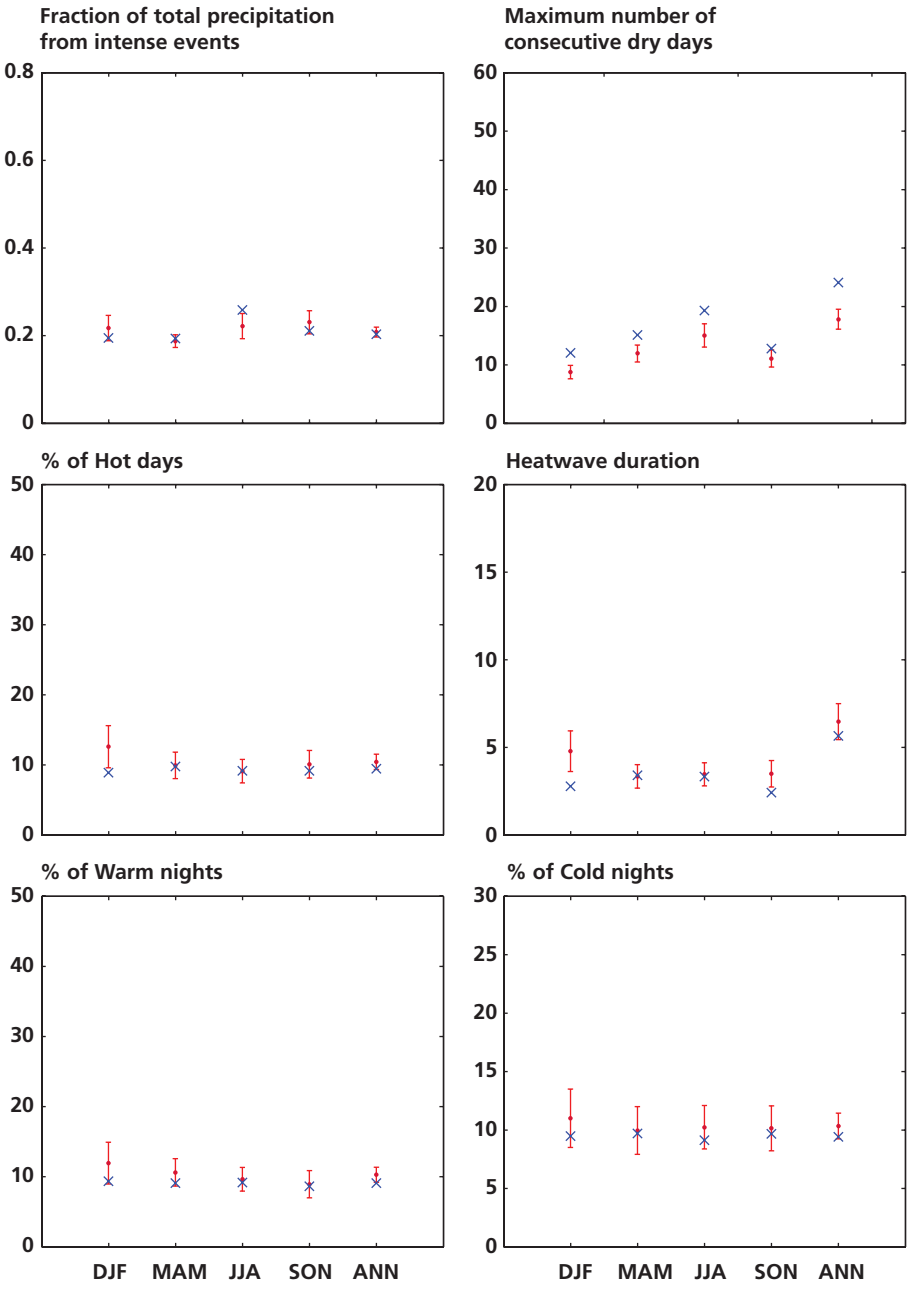

Figure 4c. Validation plot for calibration on Dale Fort observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Eskdalemuir

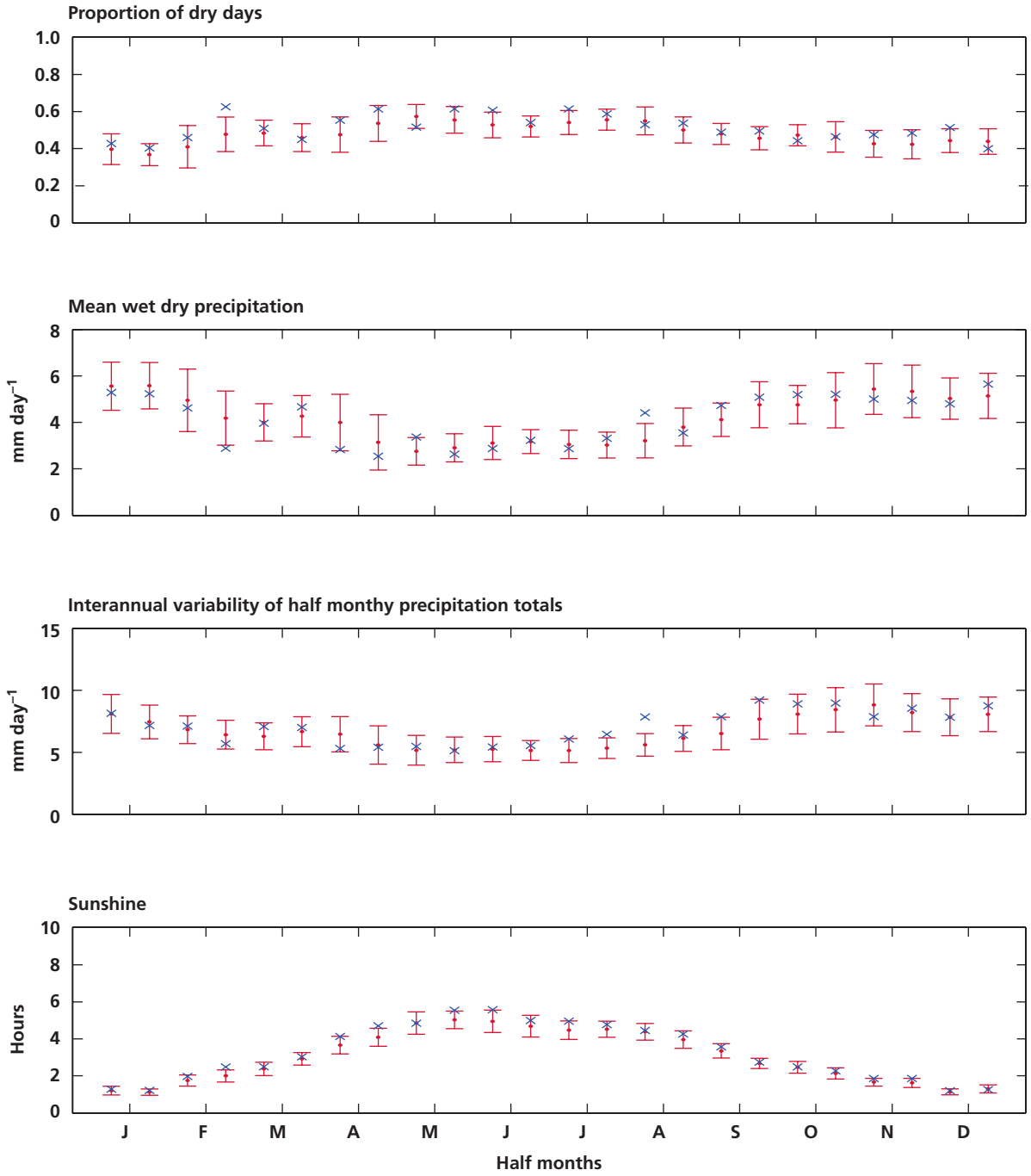

Figure 5a. Validation plot for calibration on Eskdalemuir observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Eskdalemuir

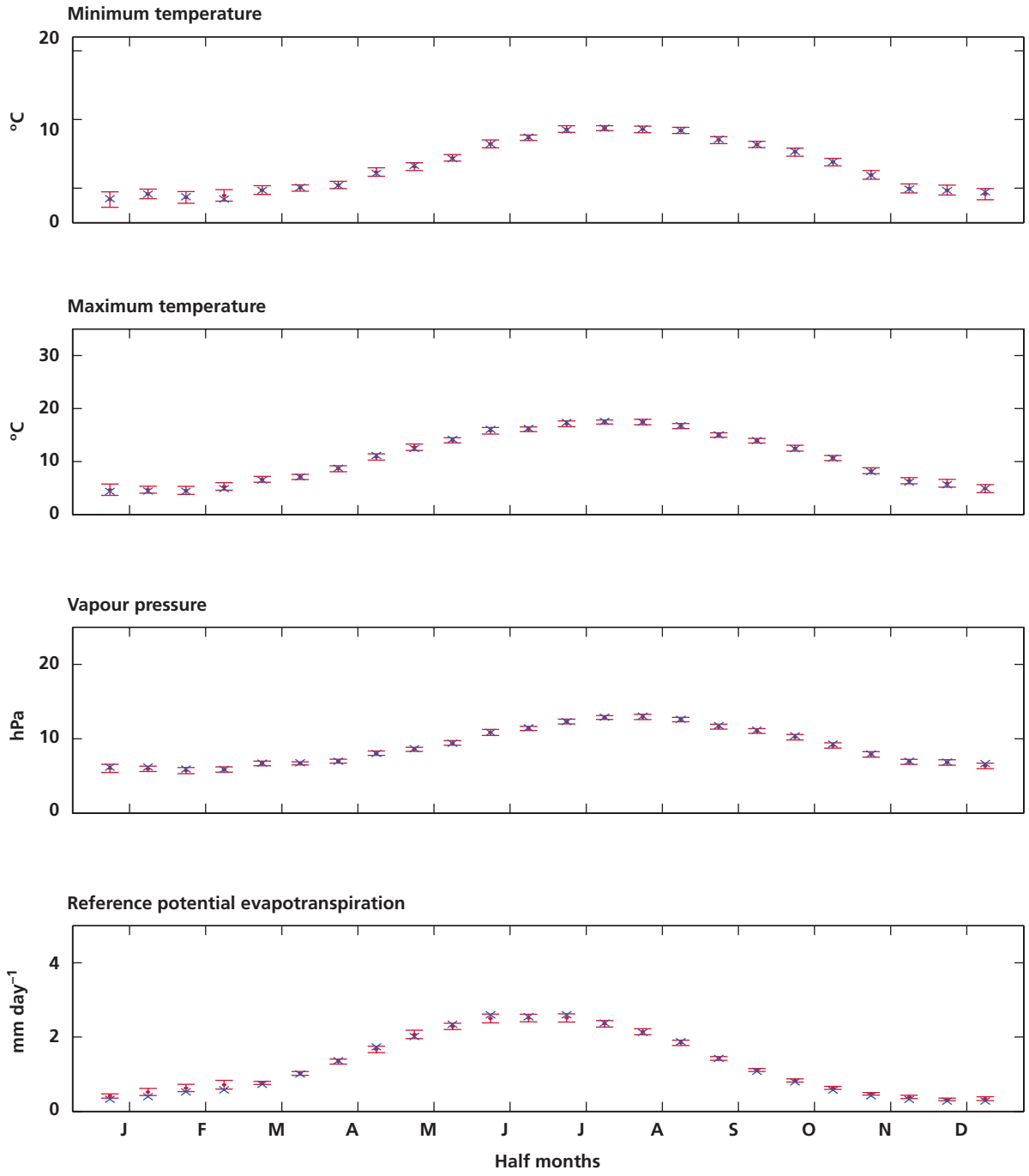

Figure 5b. Validation plot for calibration on Eskdalemuir observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Eskdalemuir

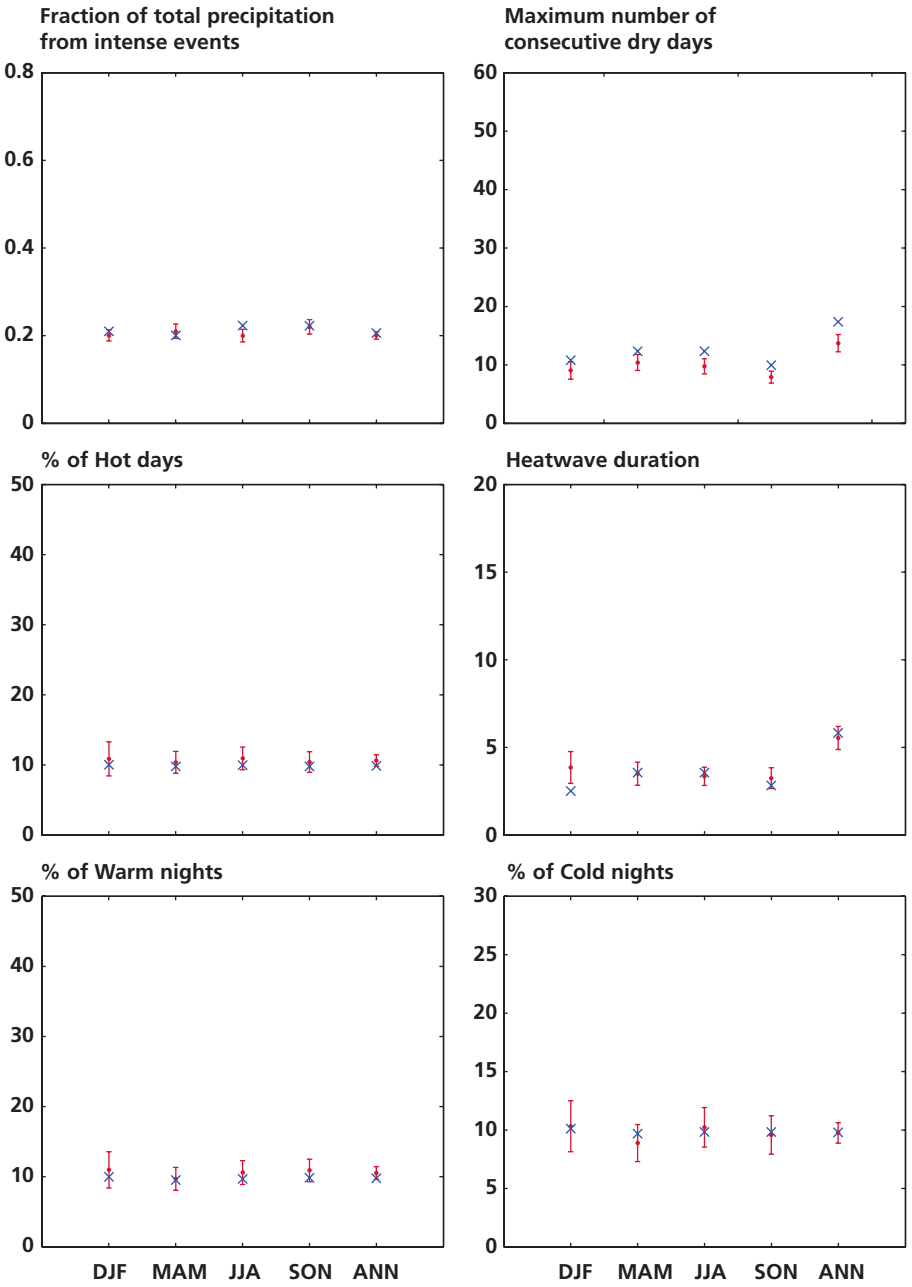

Figure 5c. Validation plot for calibration on Eskdalemuir observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Heathrow

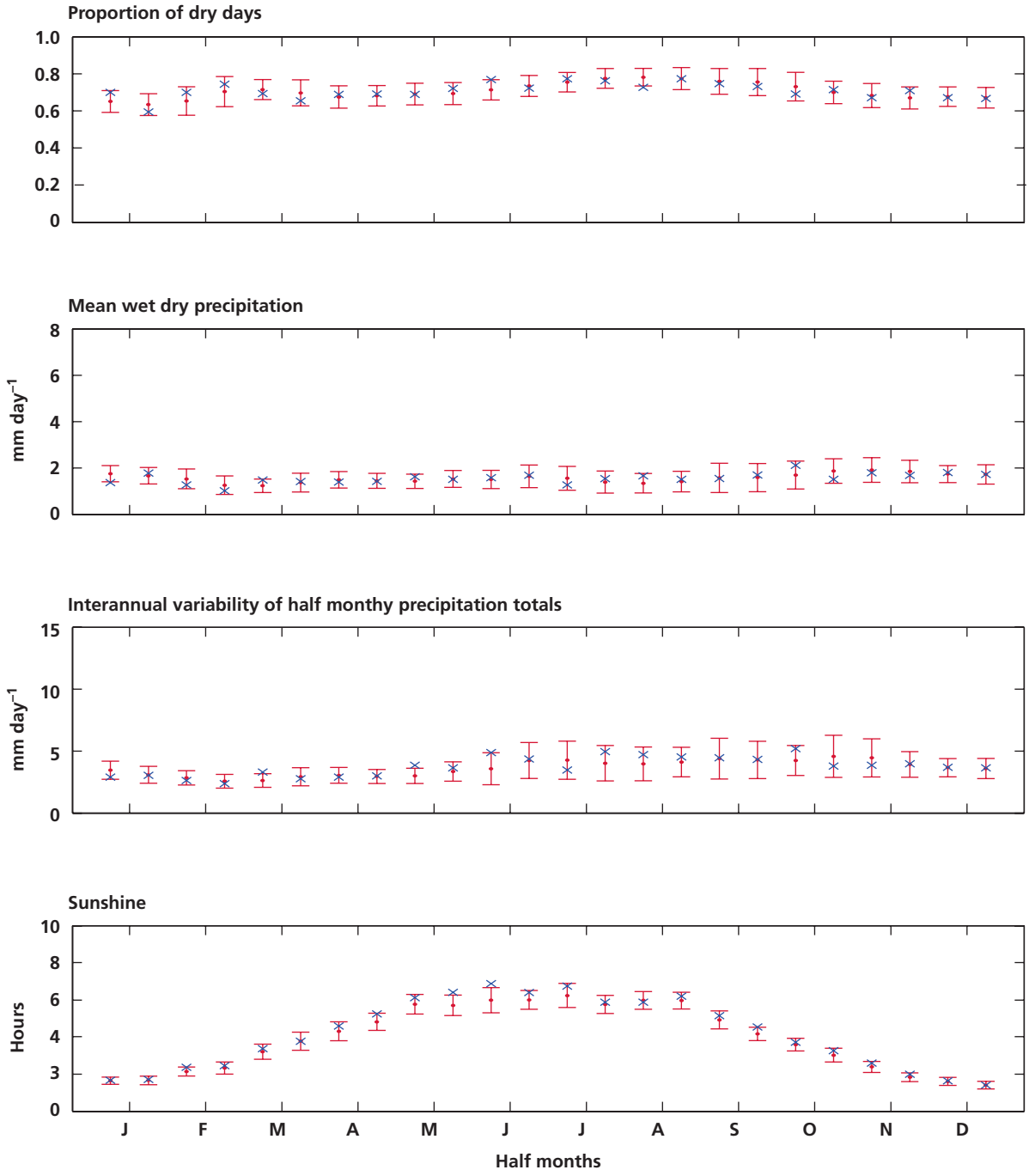

Figure 6a. Validation plot for calibration on Heathrow observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Heathrow

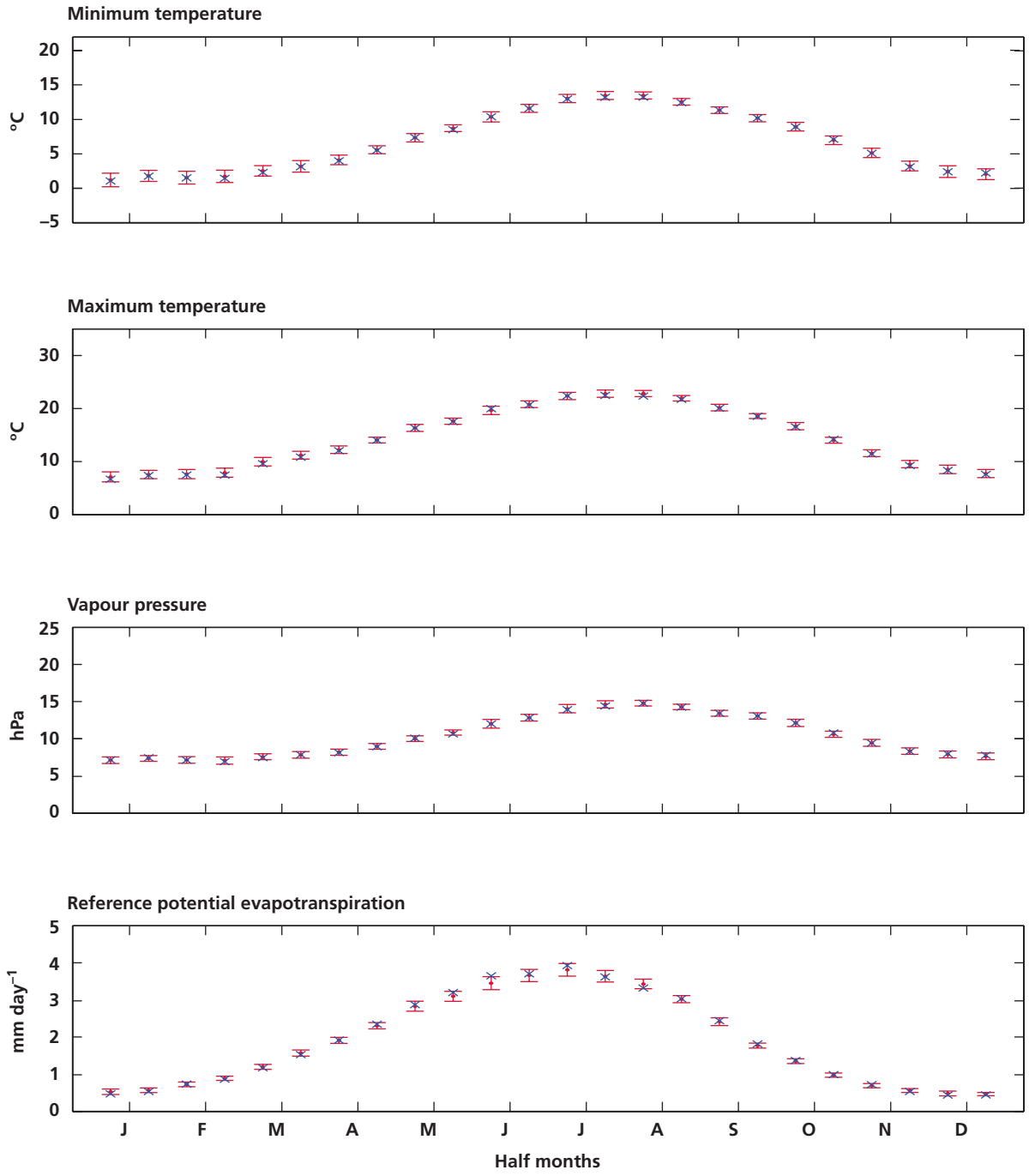

Figure 6b. Validation plot for calibration on Heathrow observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Heathrow

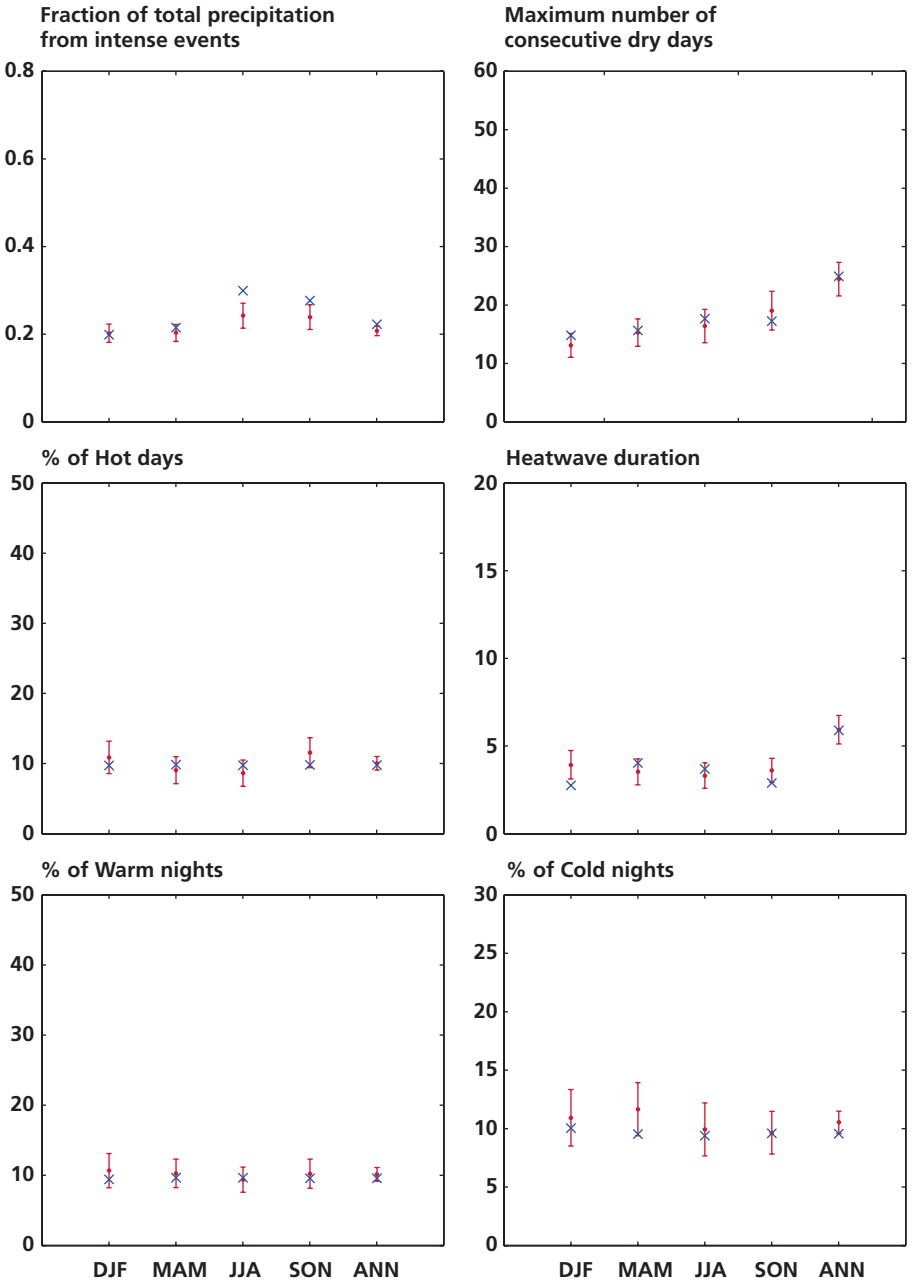

Figure 6c. Validation plot for calibration on Heathrow observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Paisley

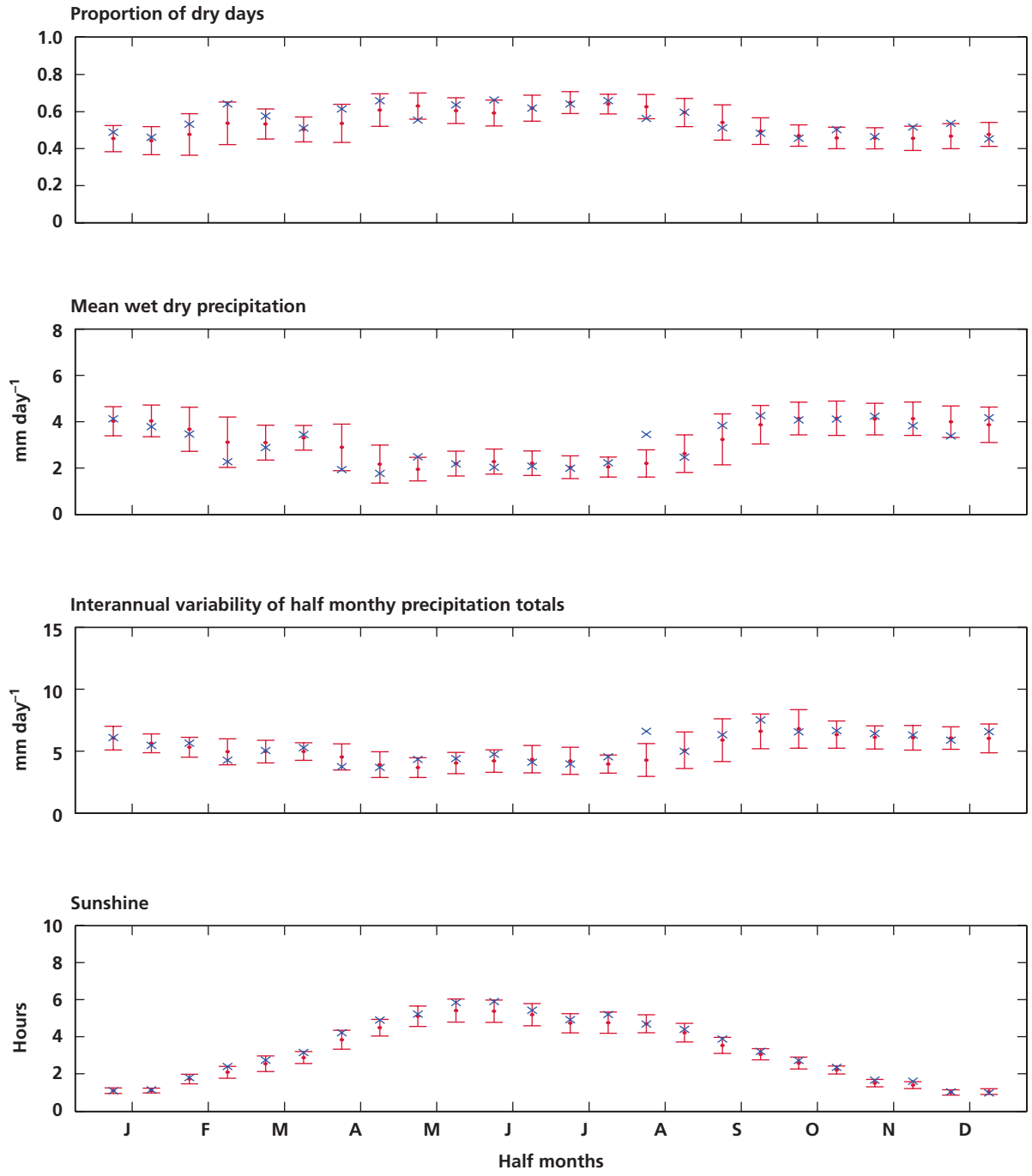

Figure 7a. Validation plot for calibration on Paisley observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Paisley

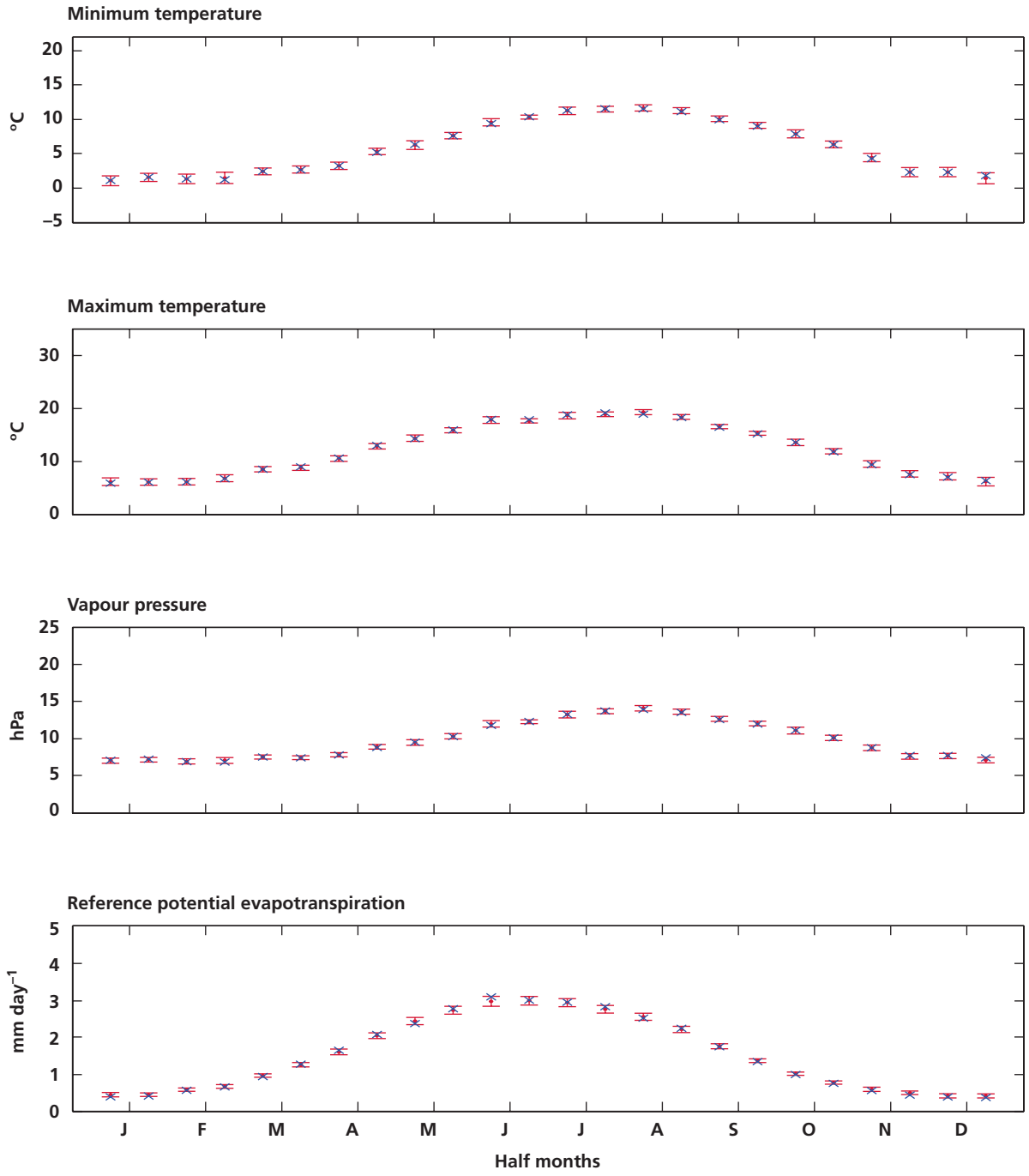

Figure 7b. Validation plot for calibration on Paisley observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Paisley

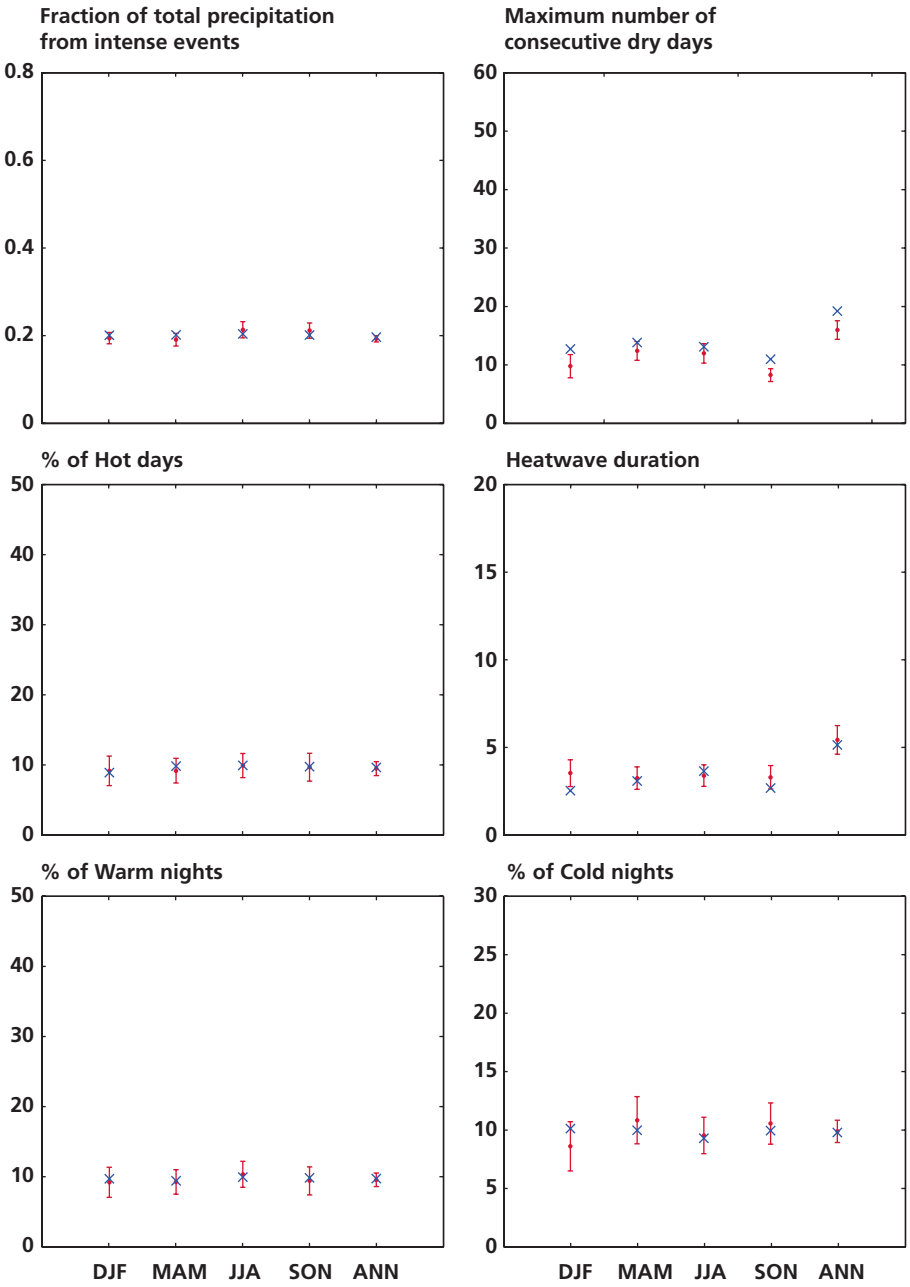

Figure 7c. Validation plot for calibration on Paisley observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Ringway

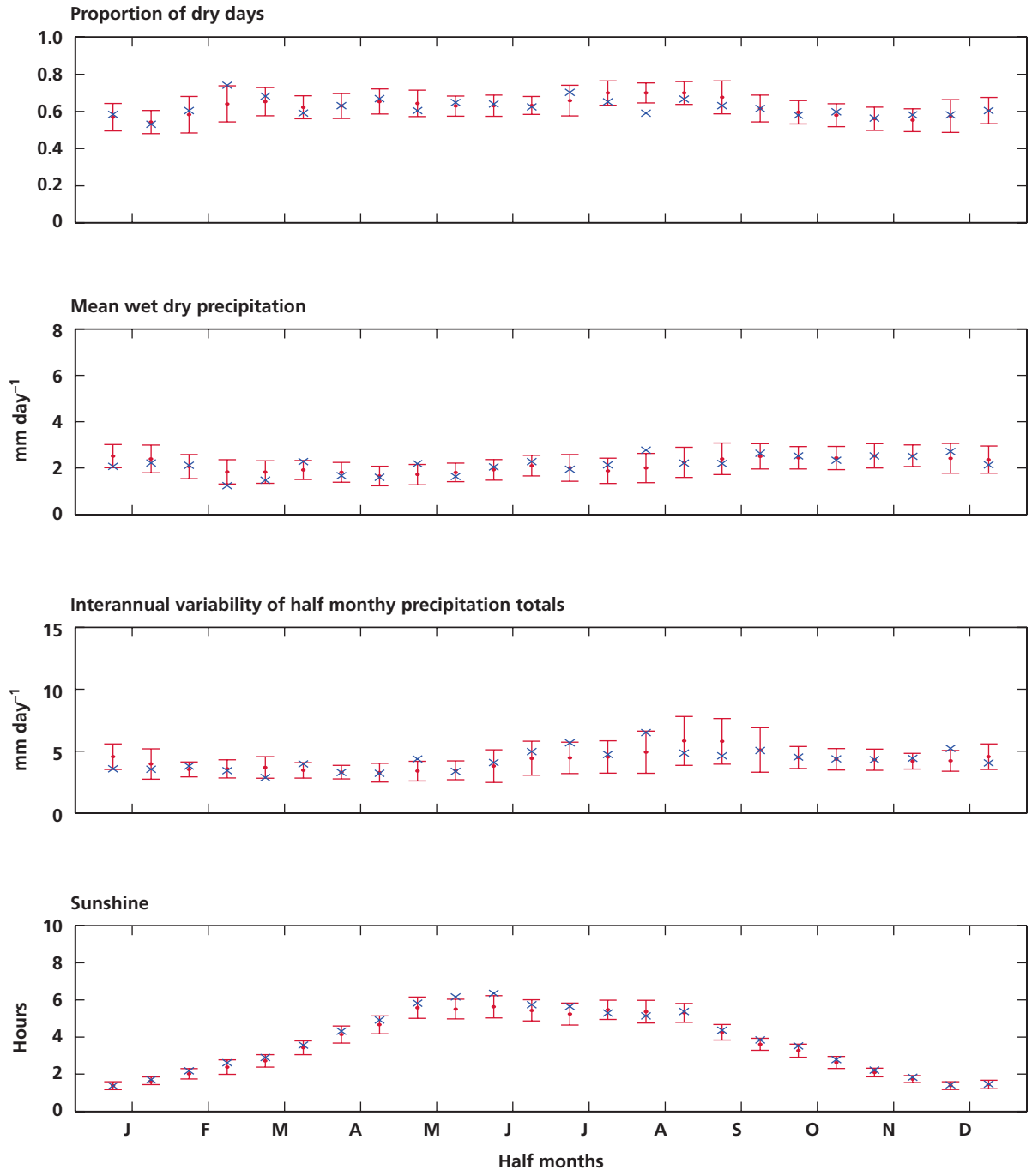

Figure 8a. Validation plot for calibration on Ringway observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Ringway

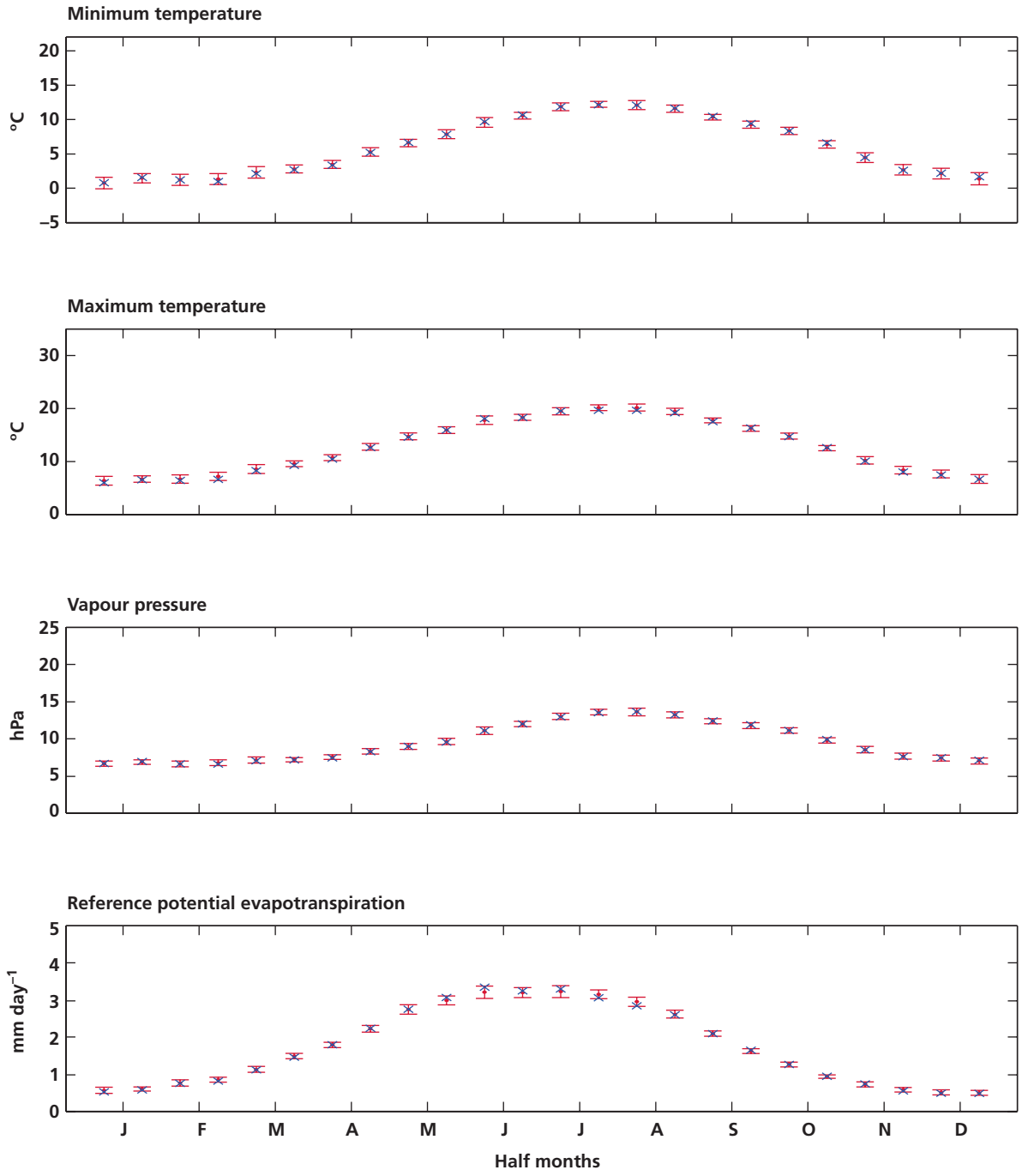

Figure 8b. Validation plot for calibration on Ringway observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Ringway

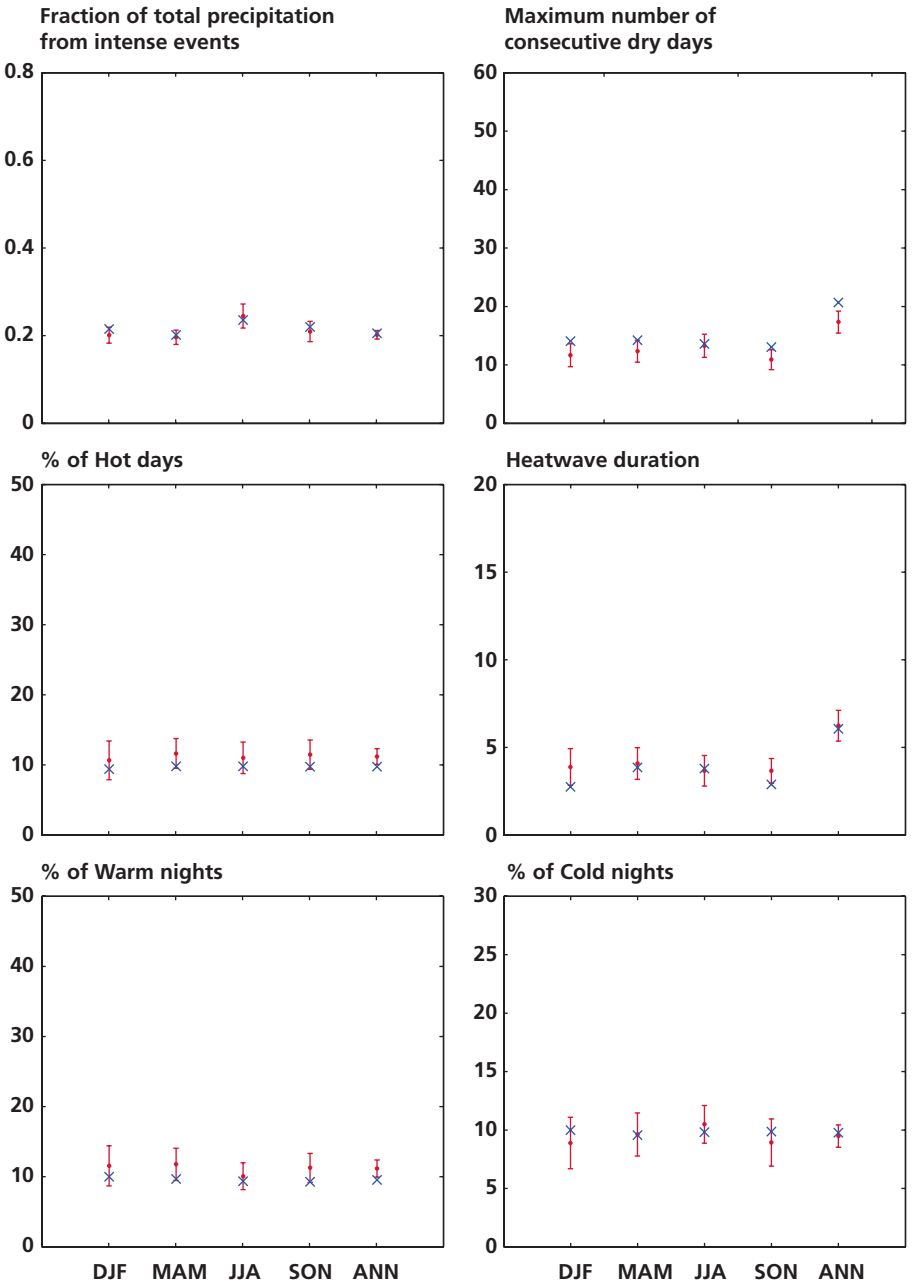

Figure 8c. Validation plot for calibration on Ringway observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Valley

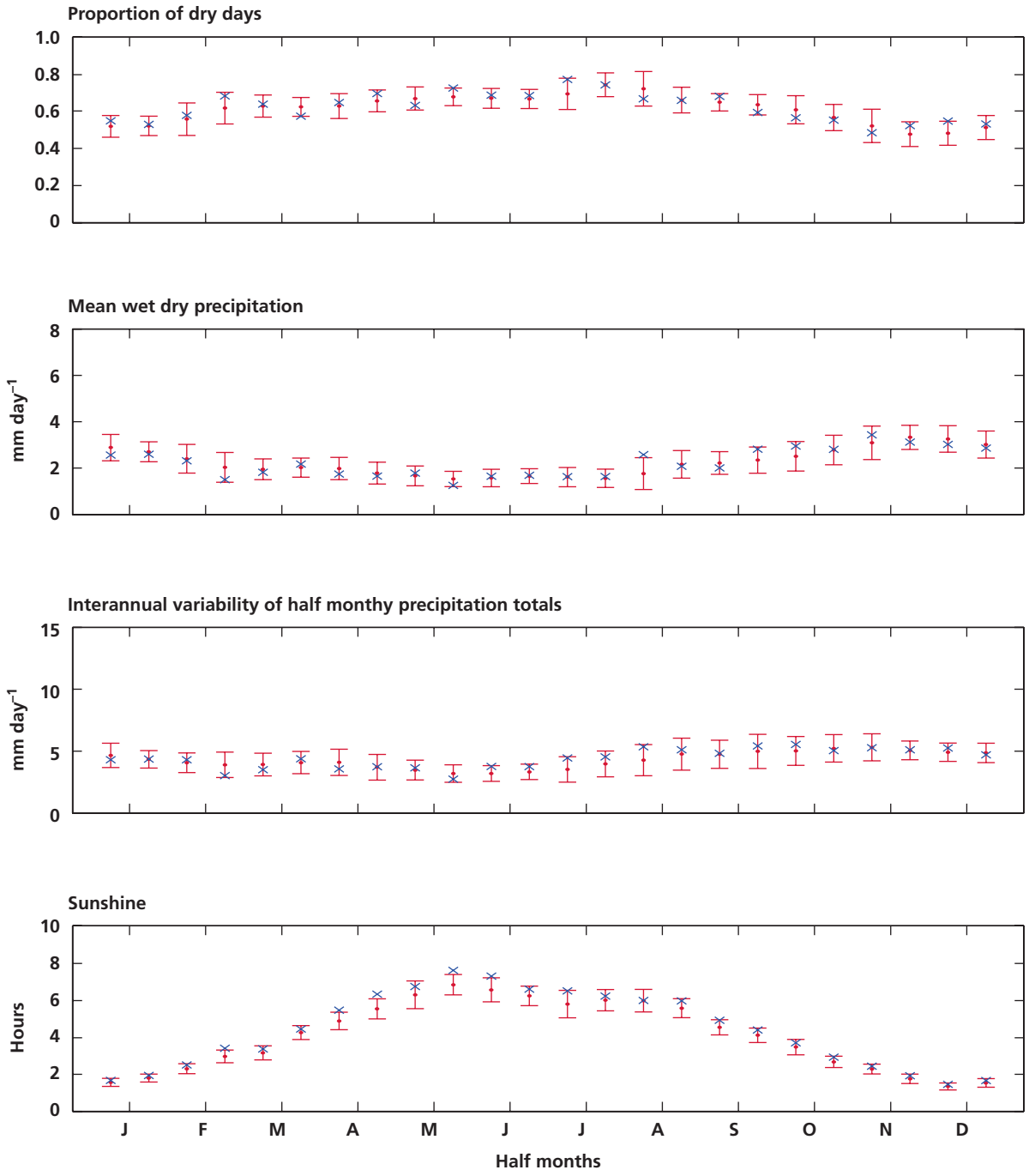

Figure 9a. Validation plot for calibration on Valley observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Valley

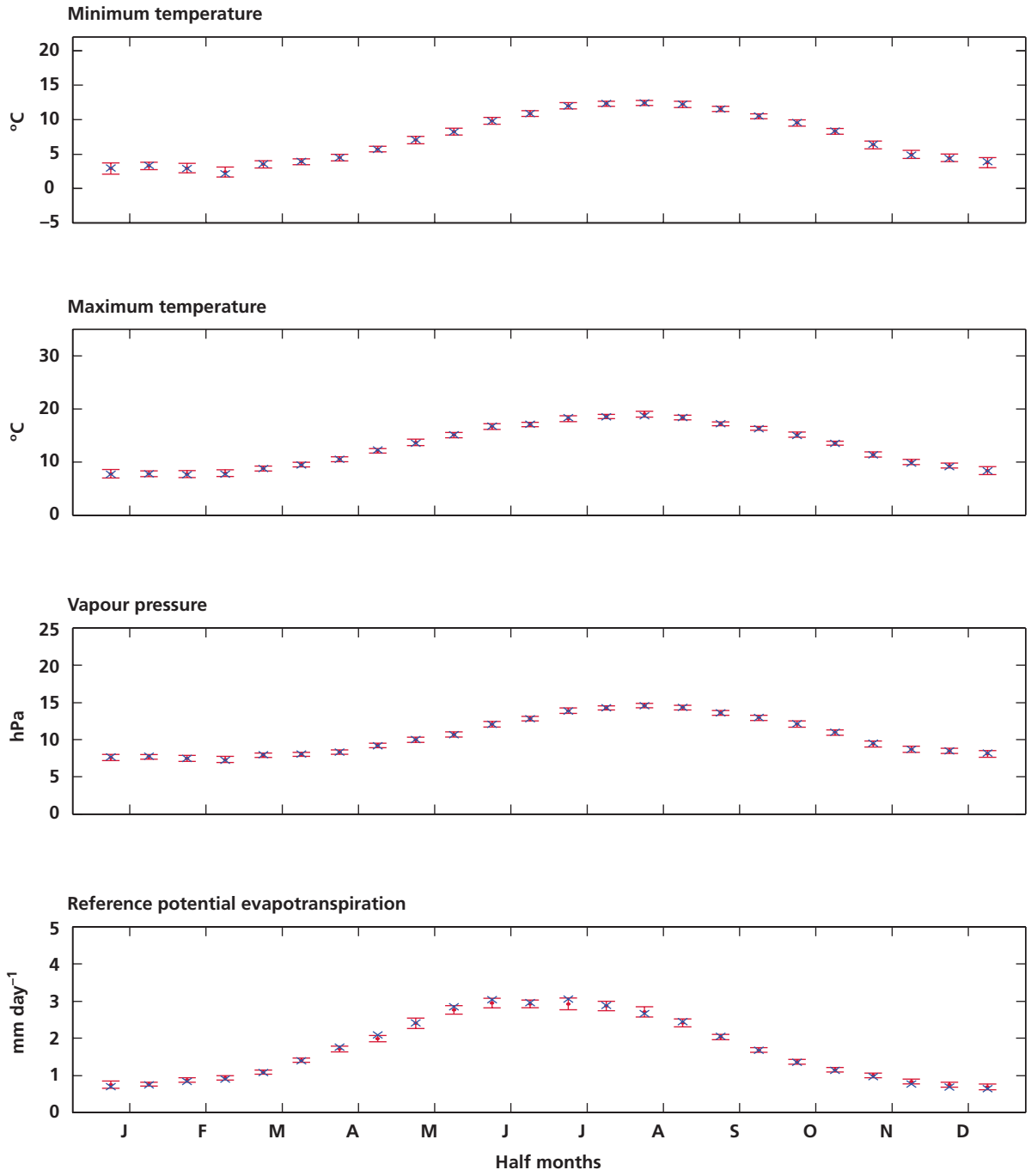

Figure 9b. Validation plot for calibration on Valley observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Valley

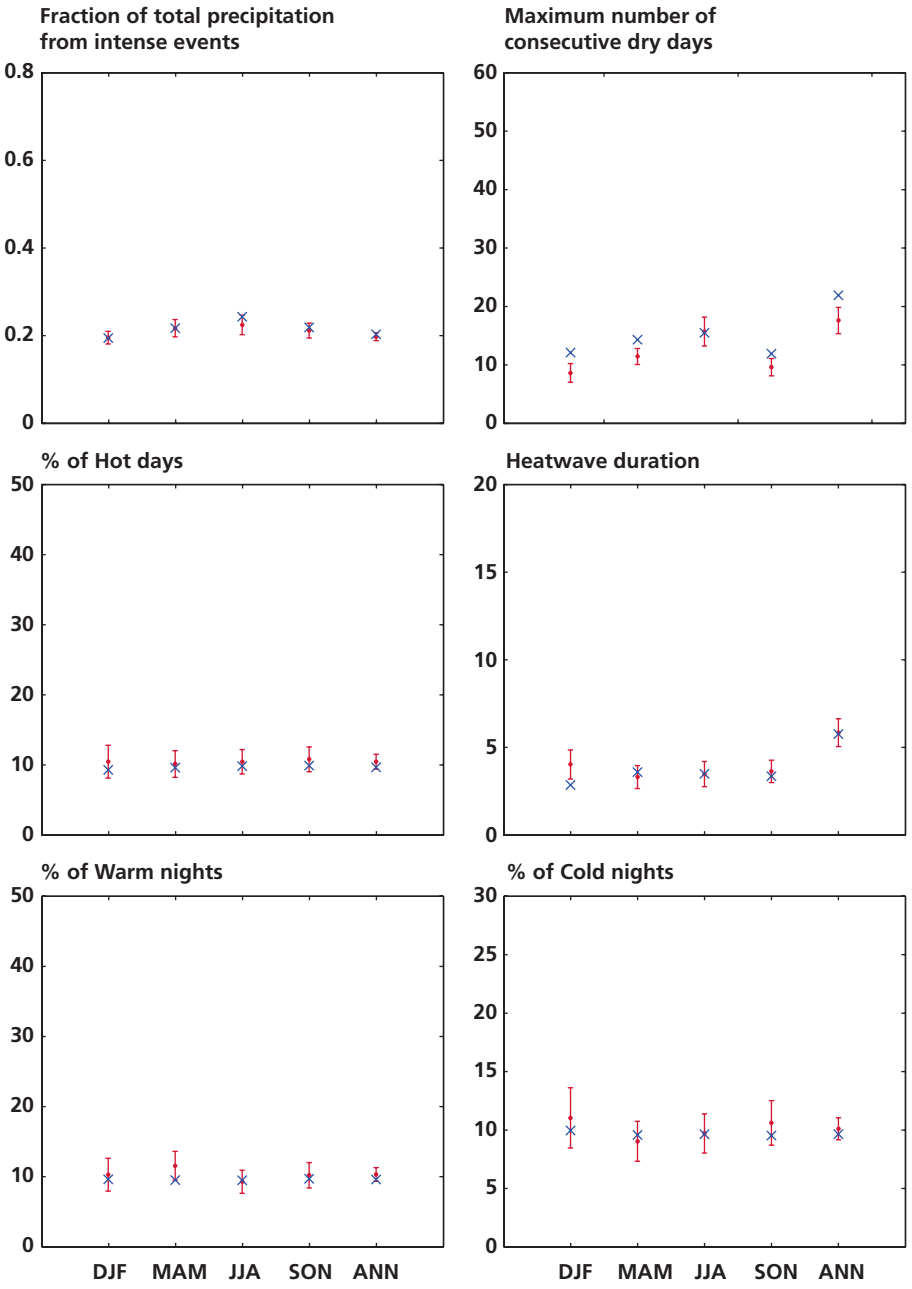

Figure 9c. Validation plot for calibration on Valley observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Wick

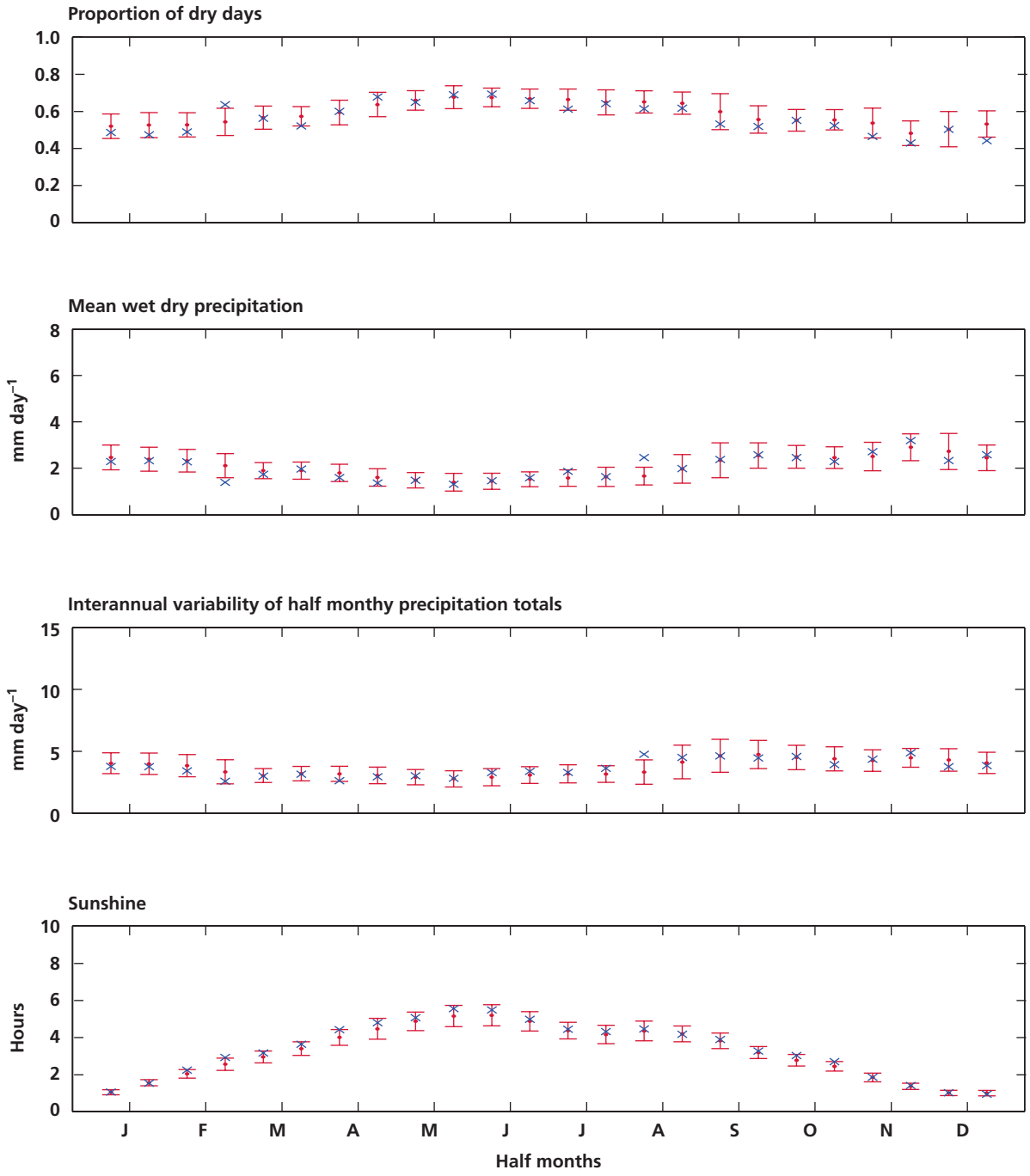

Figure 10a. Validation plot for calibration on Wick observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Wick

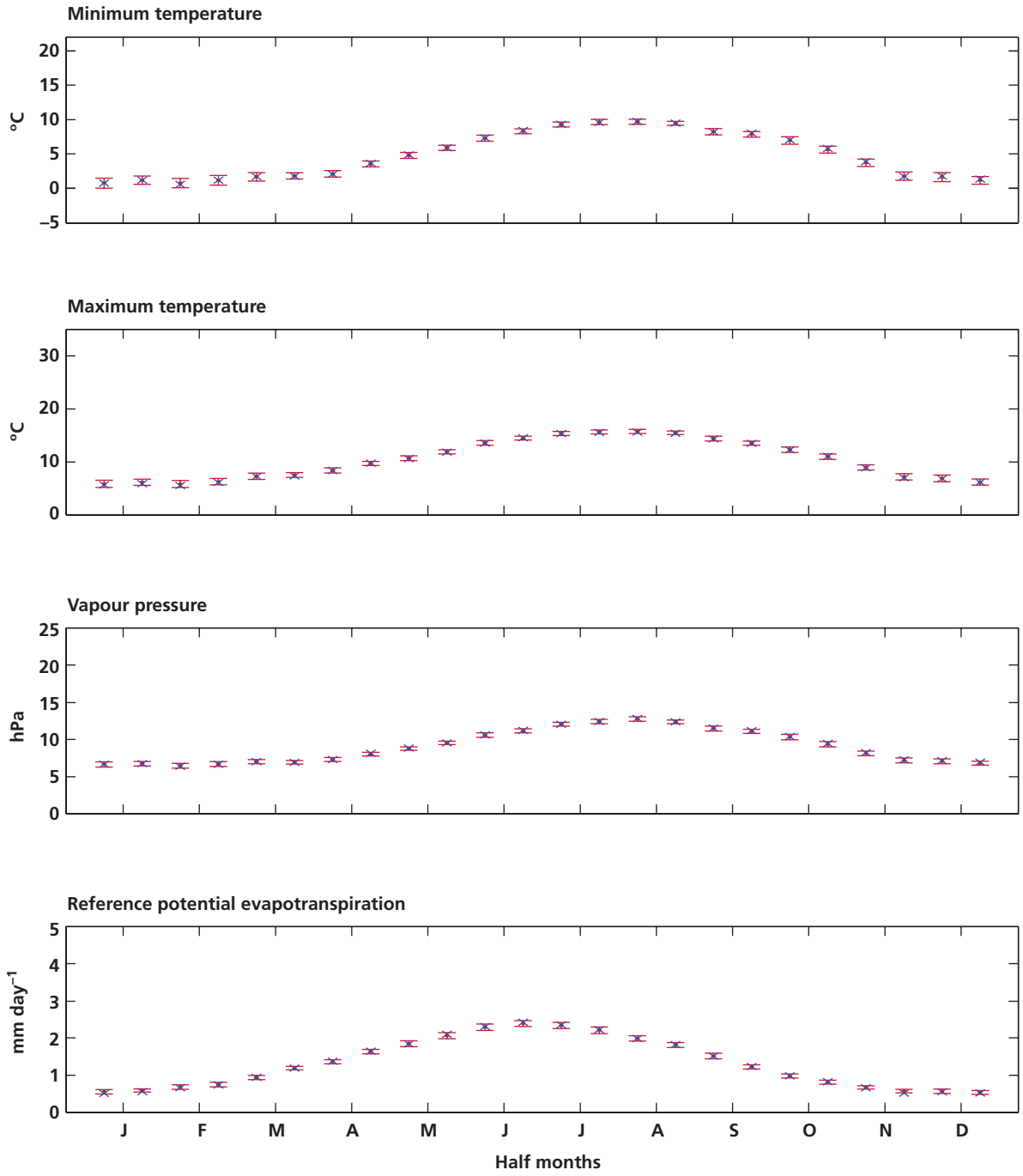

Figure 10b. Validation plot for calibration on Wick observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Wick

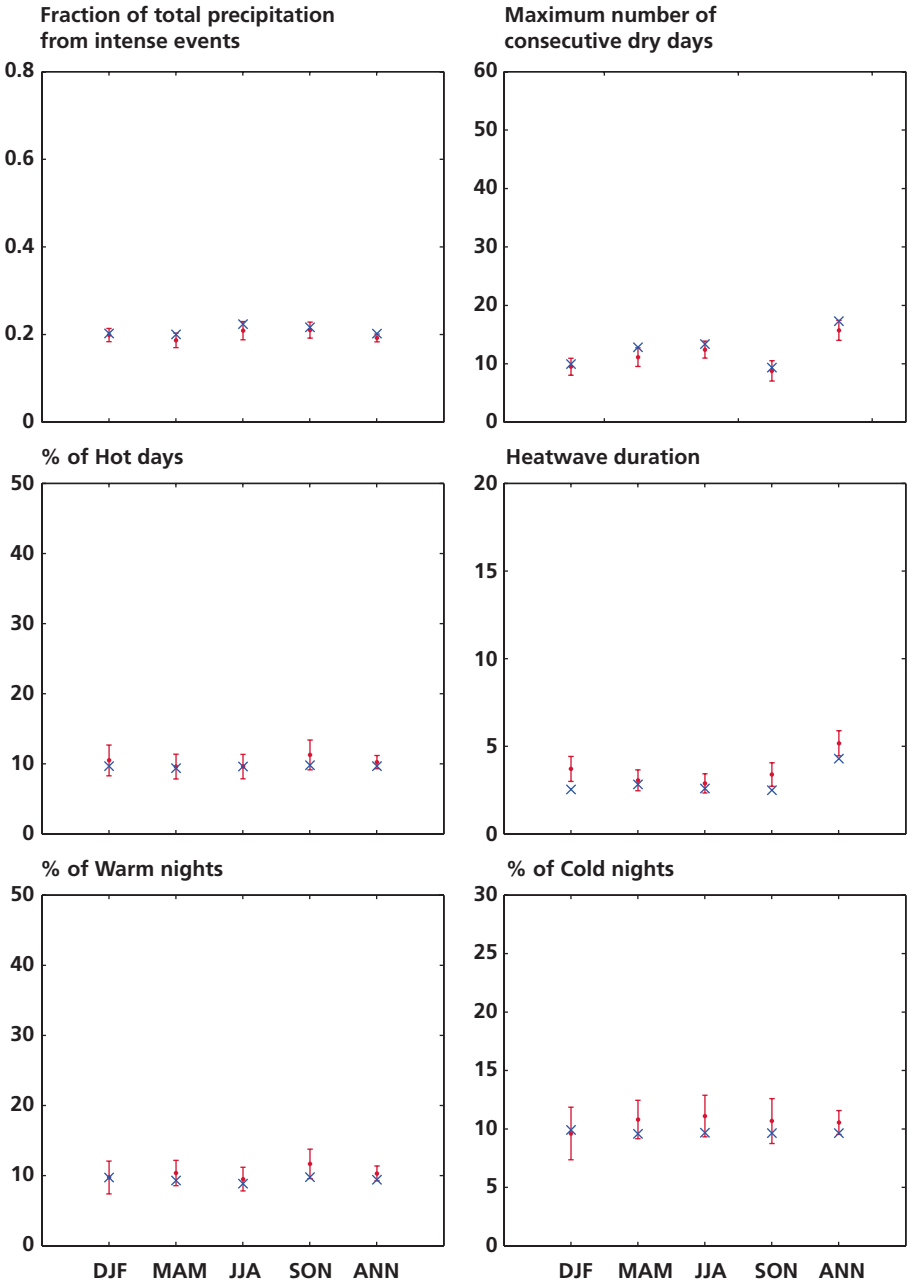

Figure 10c. Validation plot for calibration on Wick observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Yeovilton

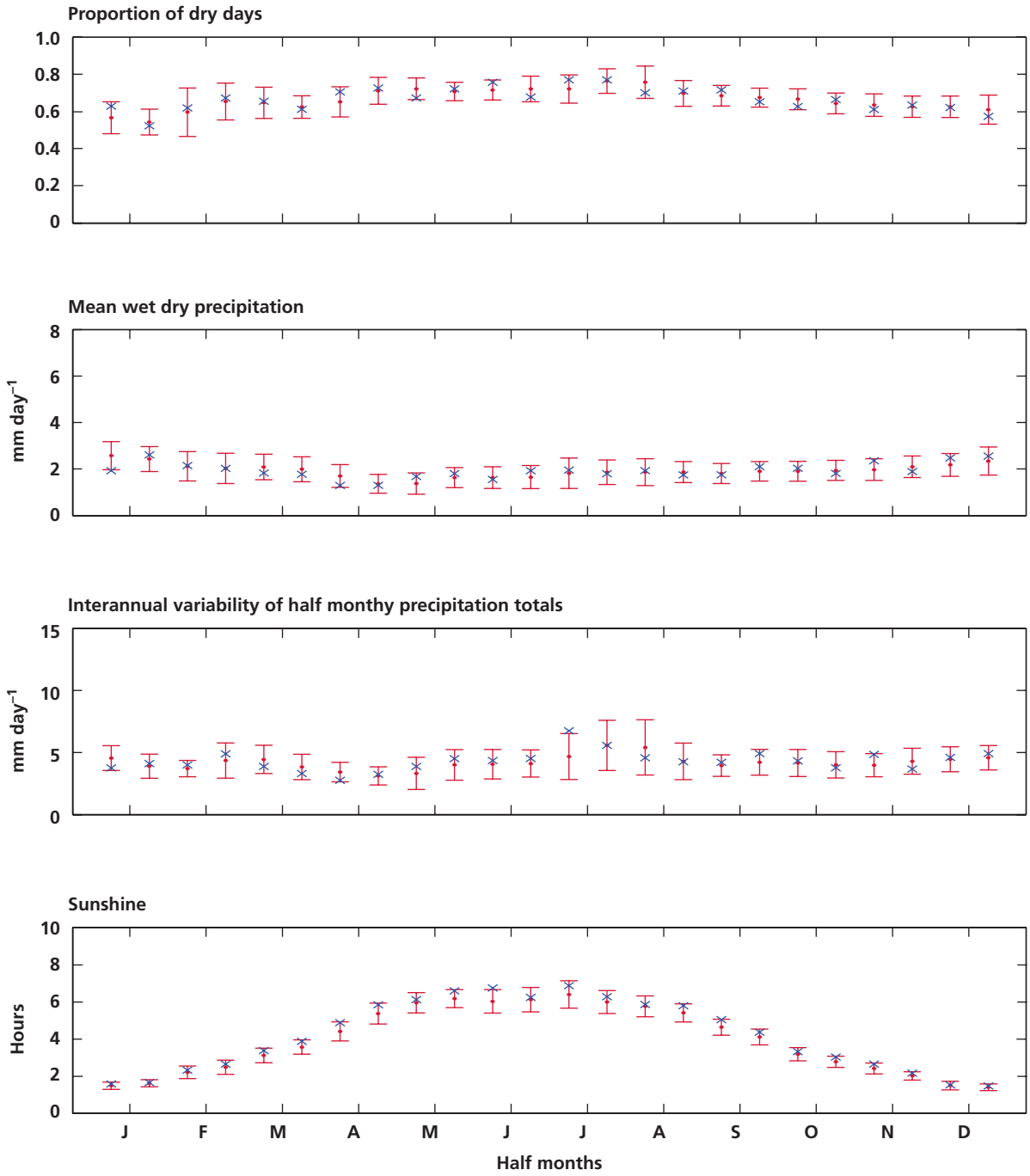

Figure 11a. Validation plot for calibration on Yeovilton observed data based on a 1961–1990 period (blue crosses) for three precipitation statistics and sunshine half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Yeovilton

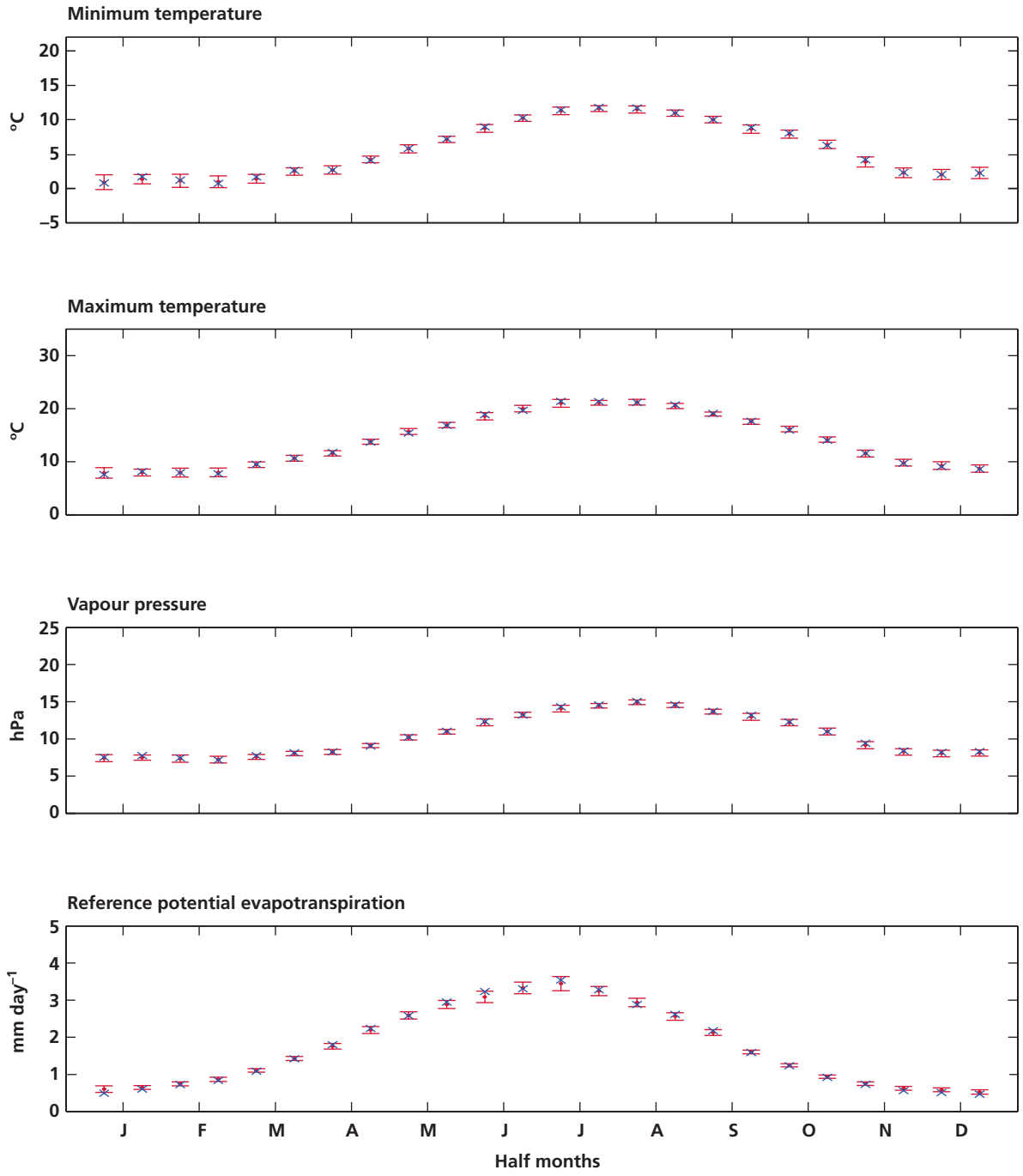

Figure 11b. Validation plot for calibration on Yeovilton observed data based on a 1961–1990 period (blue crosses) for minimum and maximum temperature, vapour pressure and PET half monthly means. The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Yeovilton

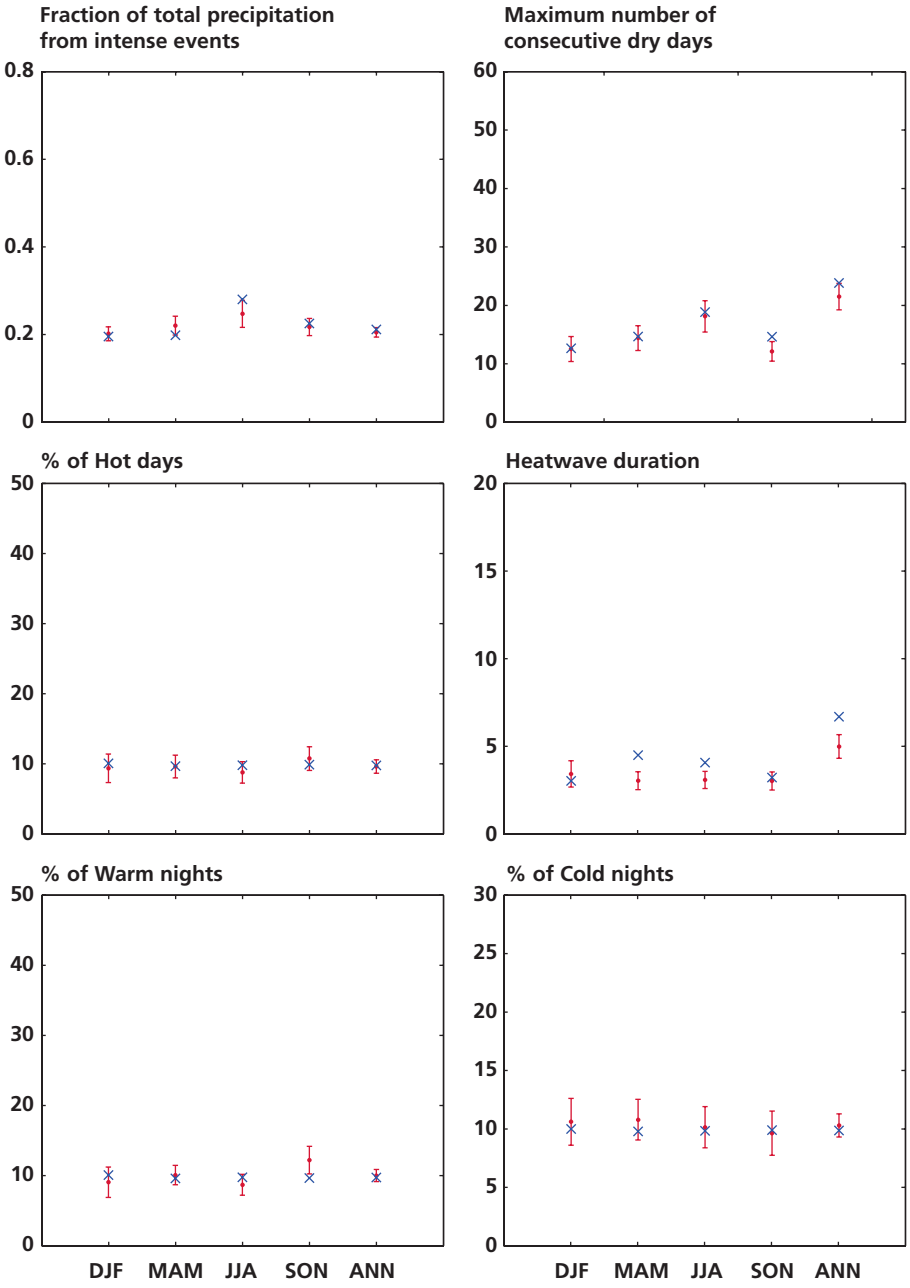

Figure 11c. Validation plot for calibration on Yeovilton observed data based on a 1961–1990 period (blue crosses) for six extreme indices calculated by the STARDEX diagnostic tool (see Table 2 for definitions). The simulated values are the means (red dots) of 100 Weather Generator runs. The red lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Weather Generator scenario validation

The Weather Generator scenario validation plots for the RCM grid cells each containing one of the 10 locations in Figure 1.

Aldergrove

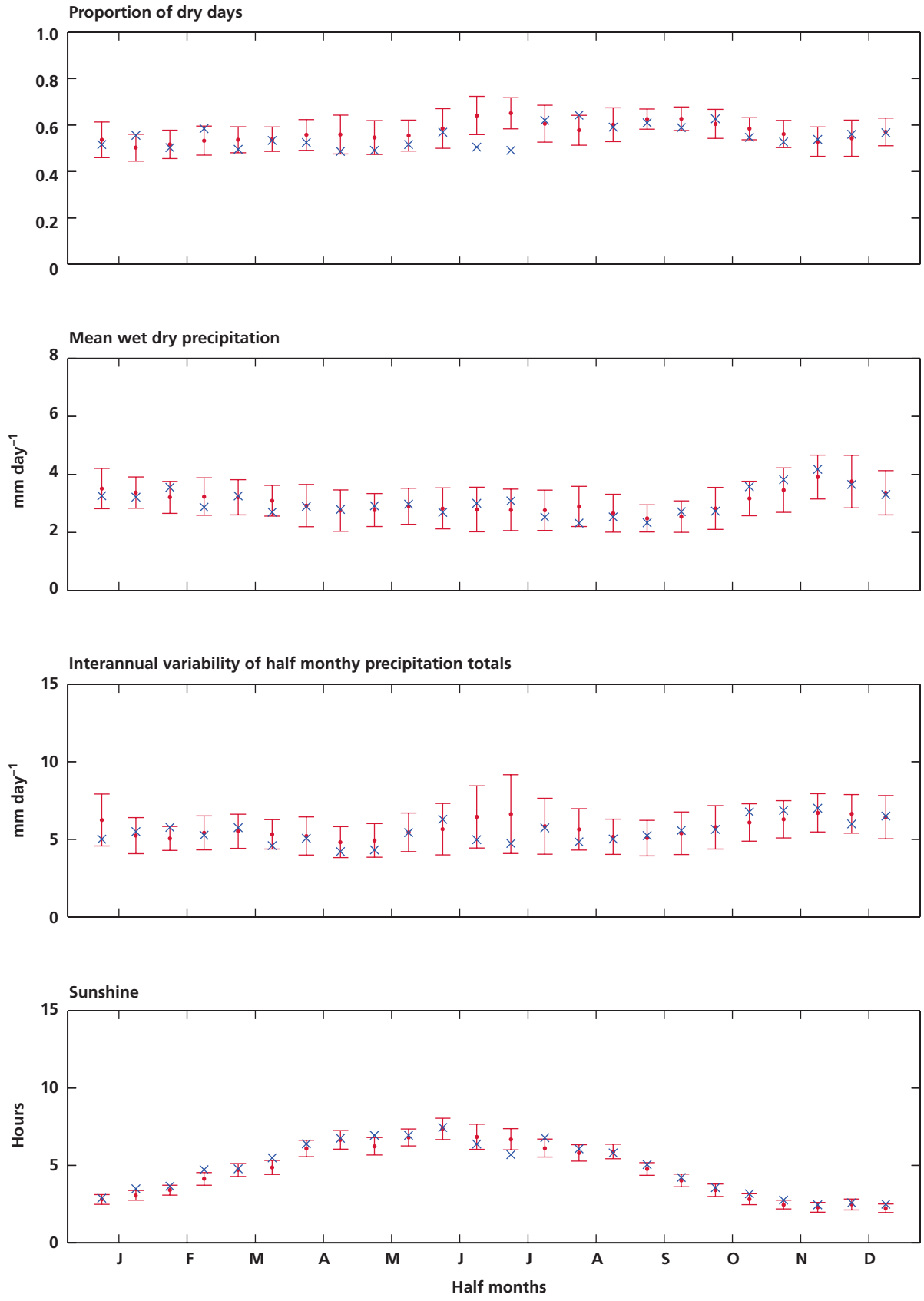

Figure 12(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Aldergrove. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Aldergrove

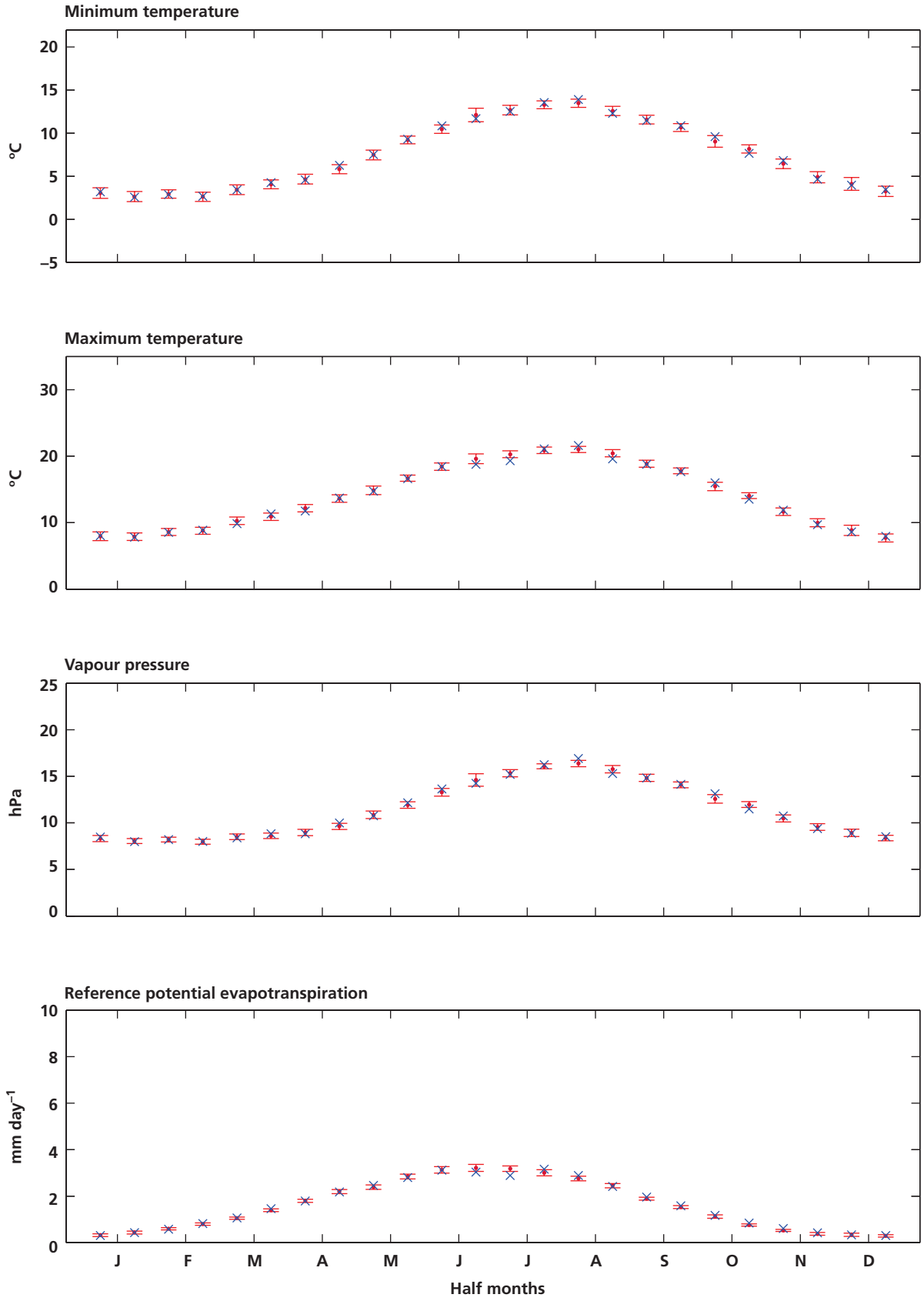

Figure 12(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Aldergrove. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Aldergrove

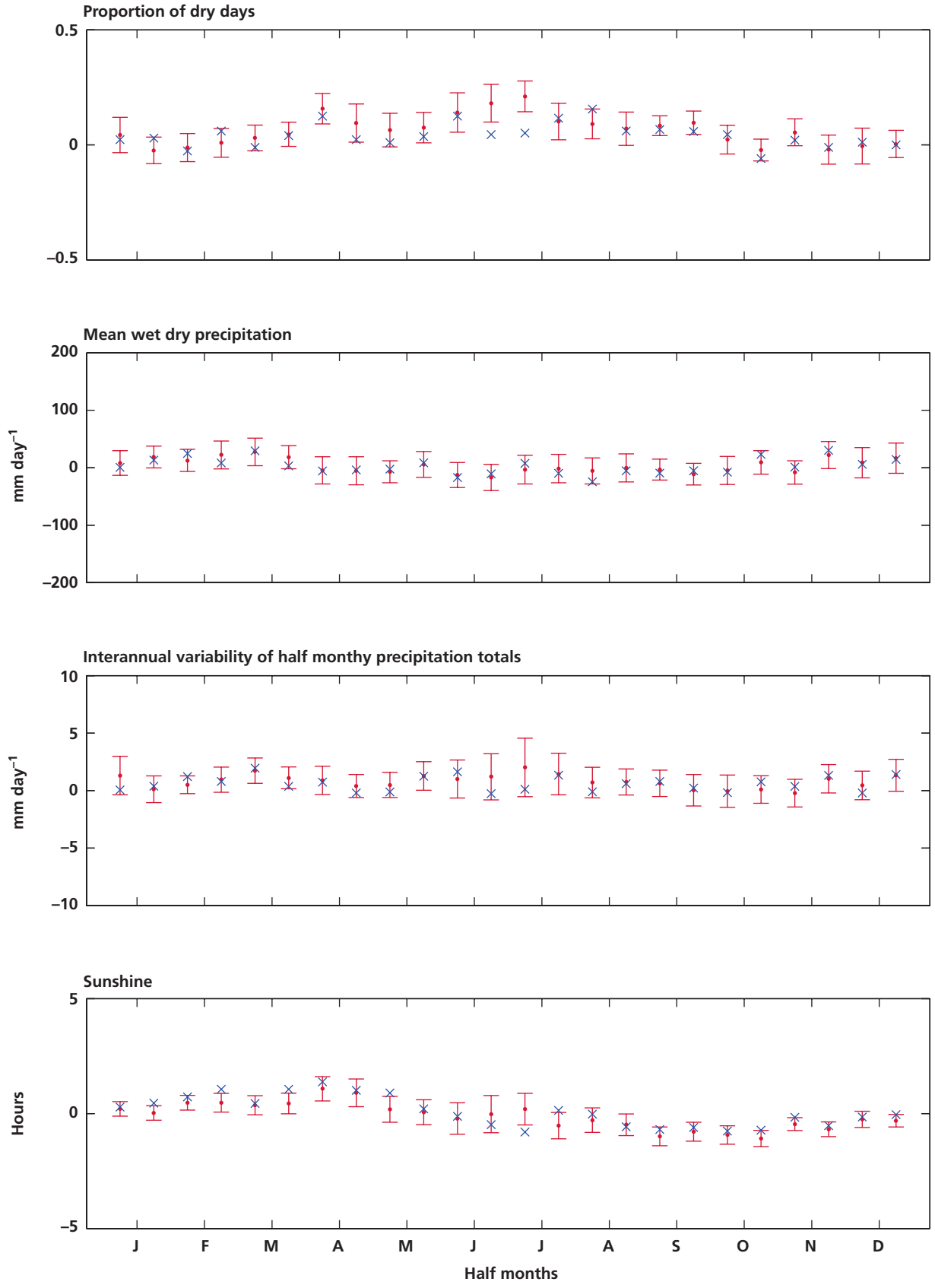

Figure 12(c): Figure 12(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Aldergrove

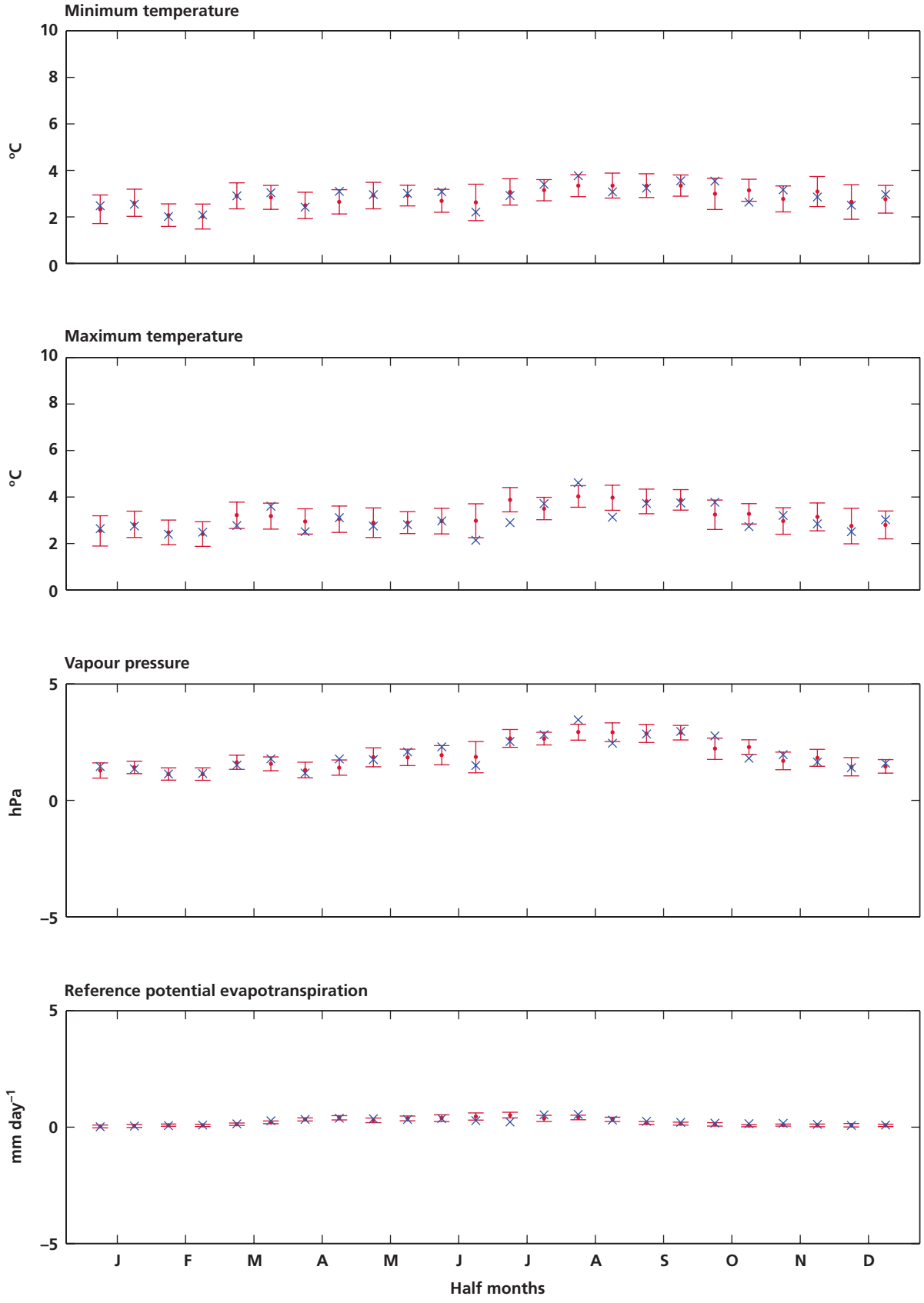

Figure 12(d): Figure 12(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Aldergrove

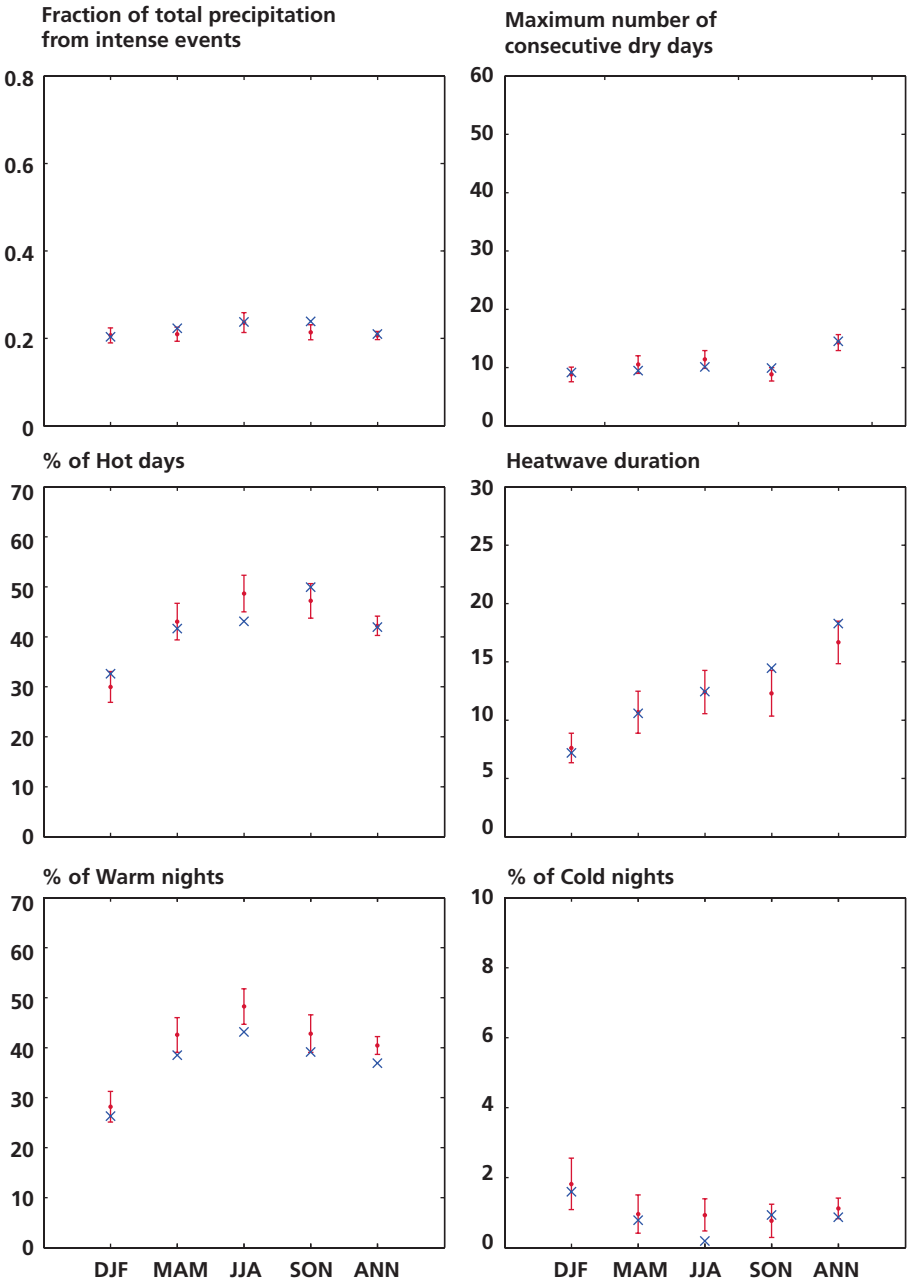

Figure 12(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Aldergrove. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Aldergrove

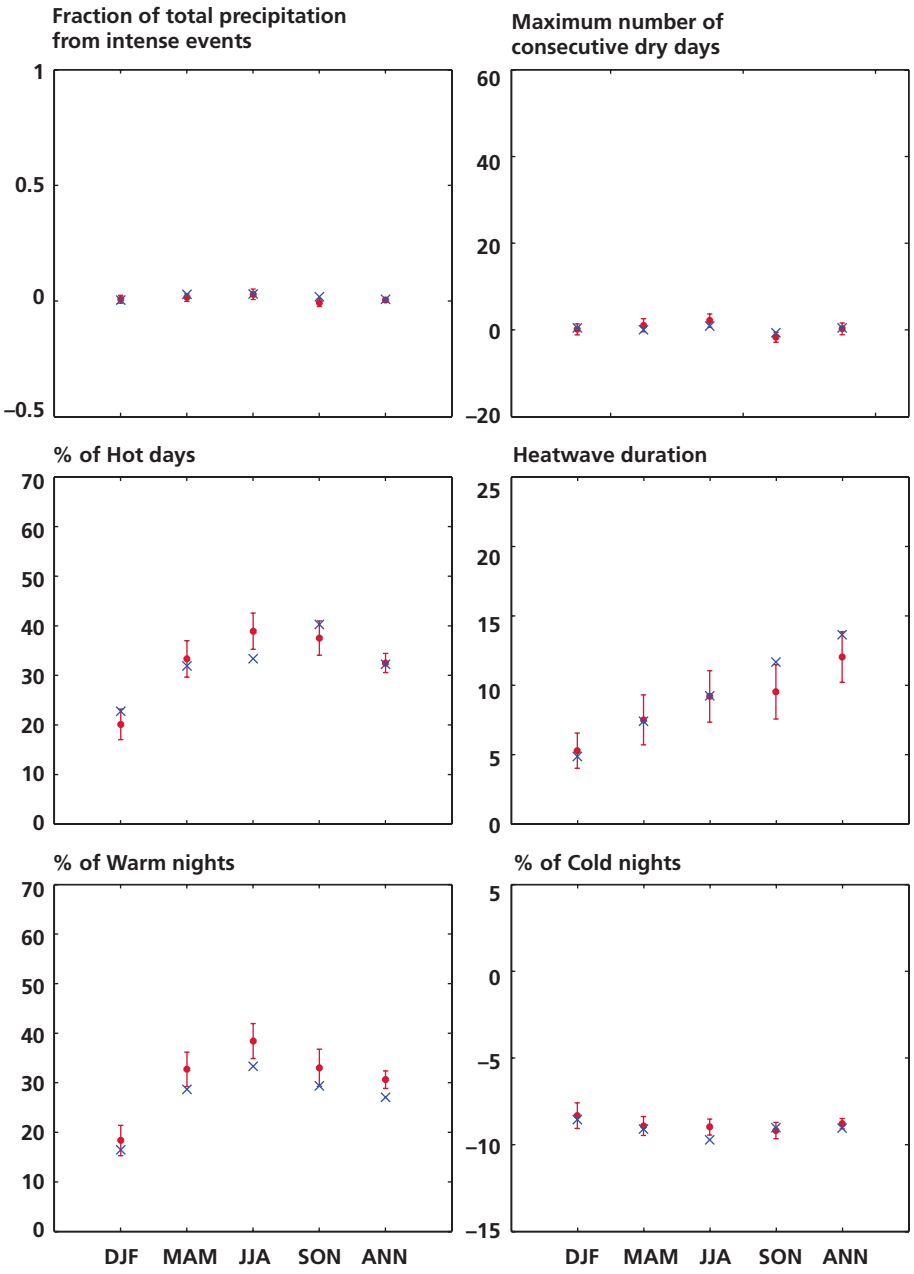

Figure 12(f): As Figure 12(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Coltishall

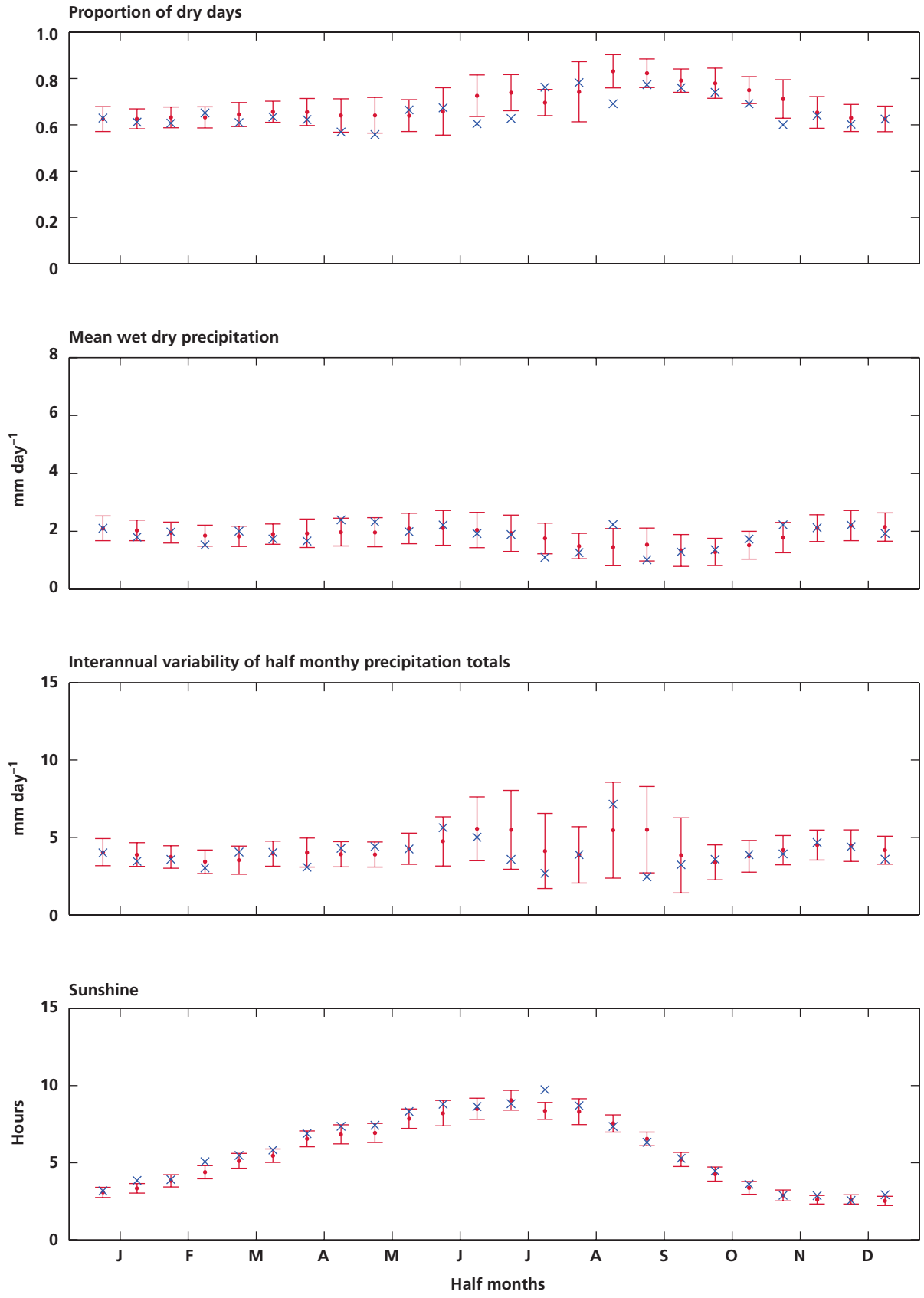

Figure 13(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Coltishall. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Coltishall

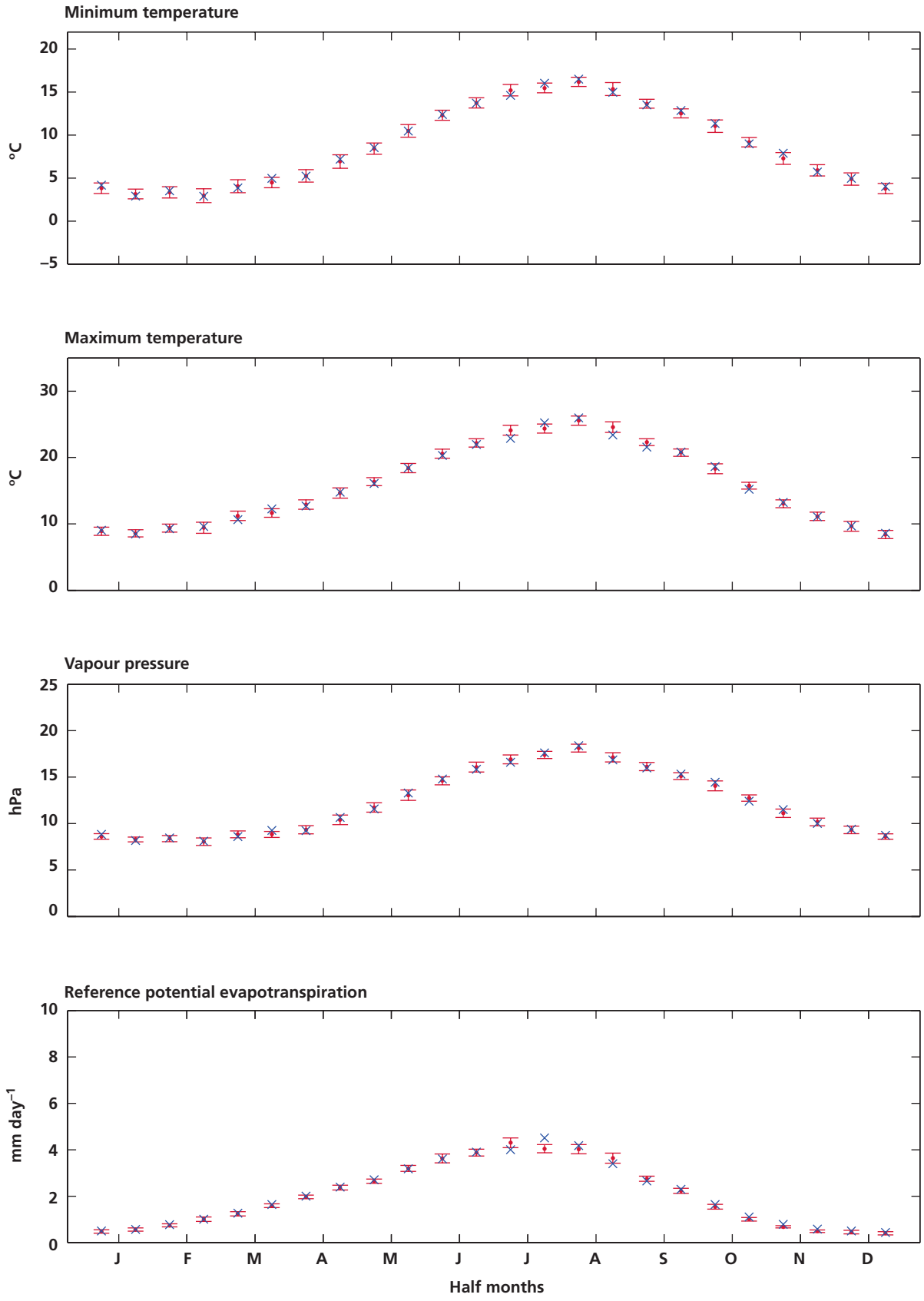

Figure 13(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Coltishall. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Coltishall

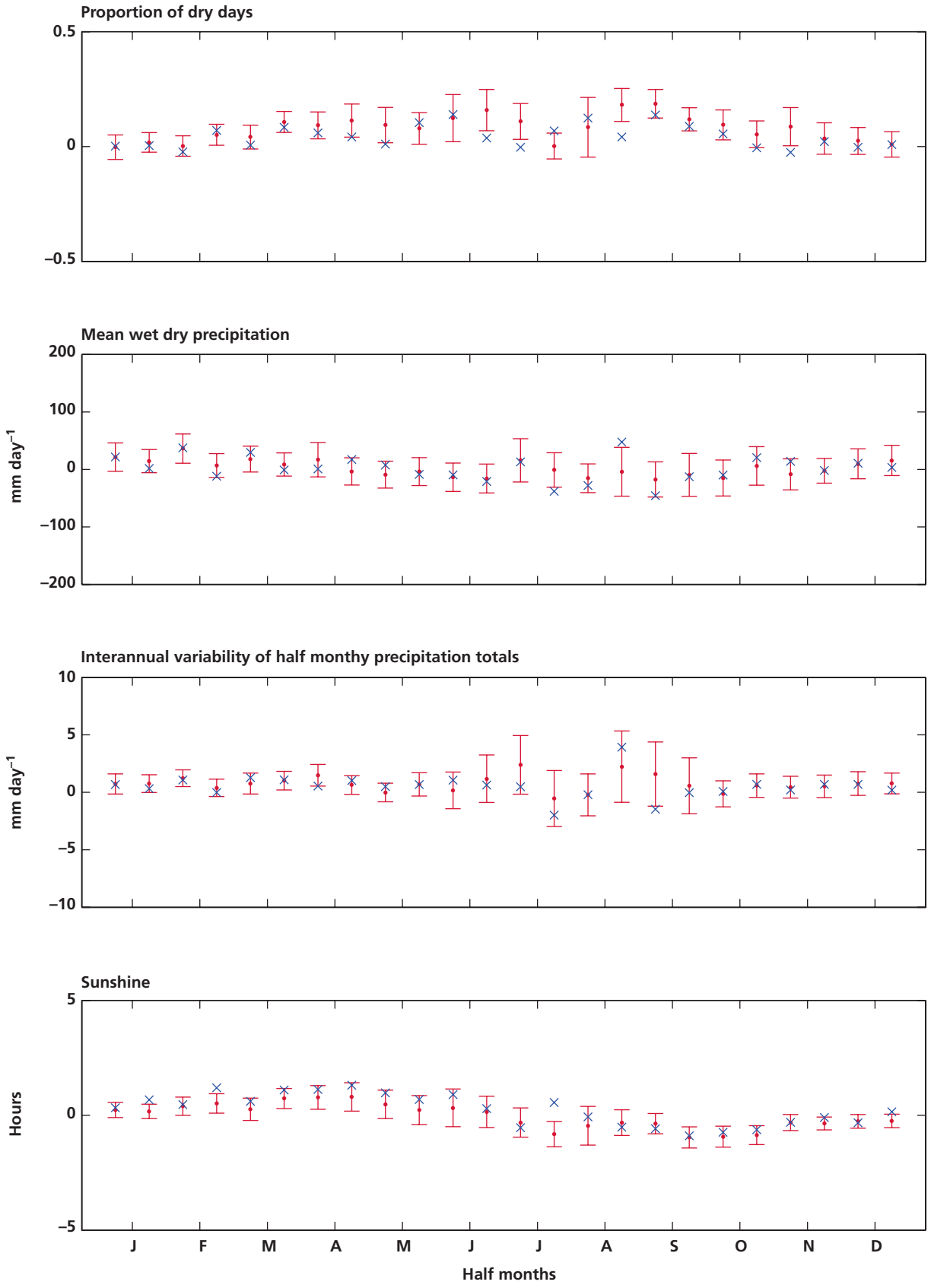

Figure 13(c): Figure 13(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Coltishall

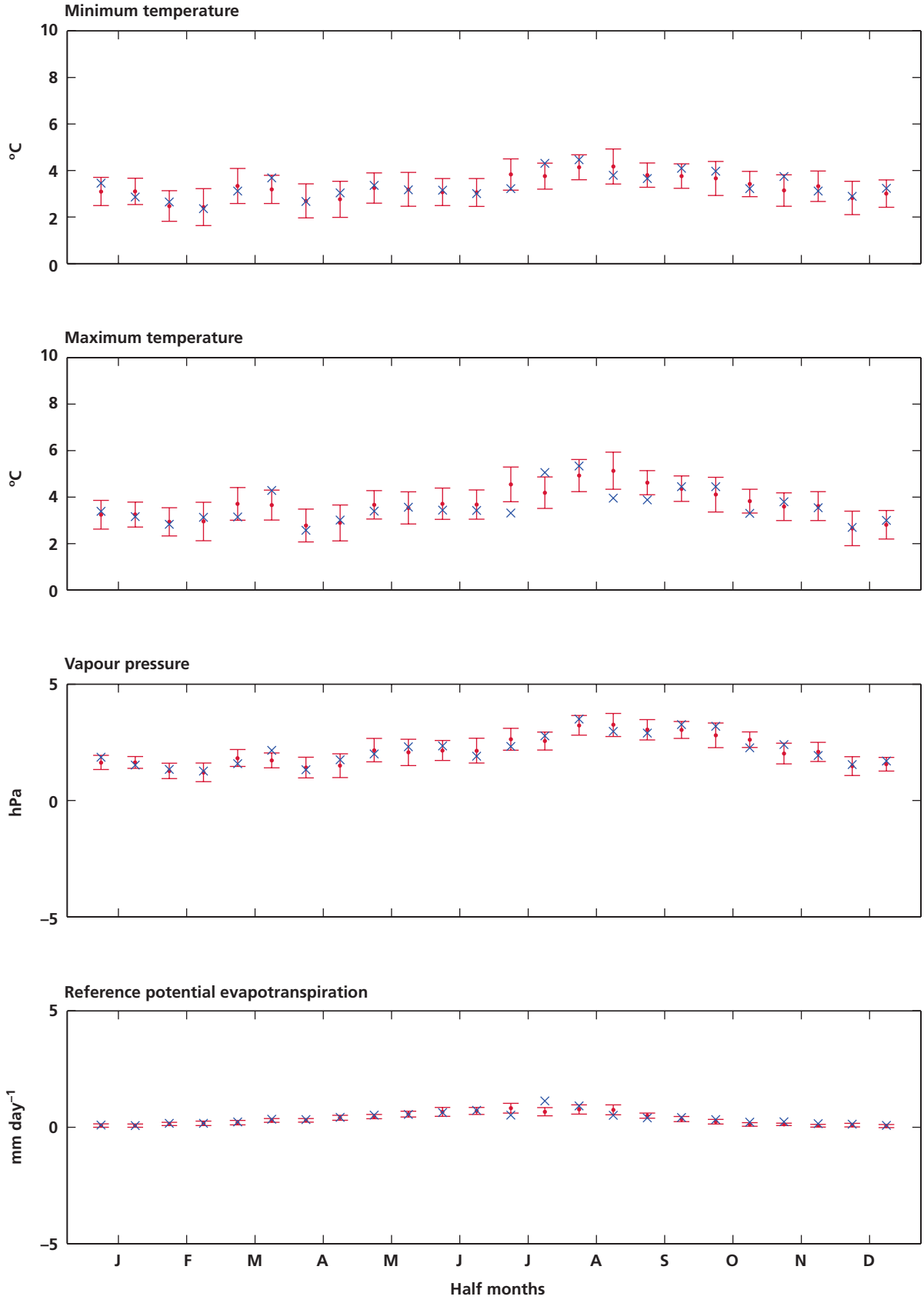

Figure 13(d): Figure 13(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Coltishall

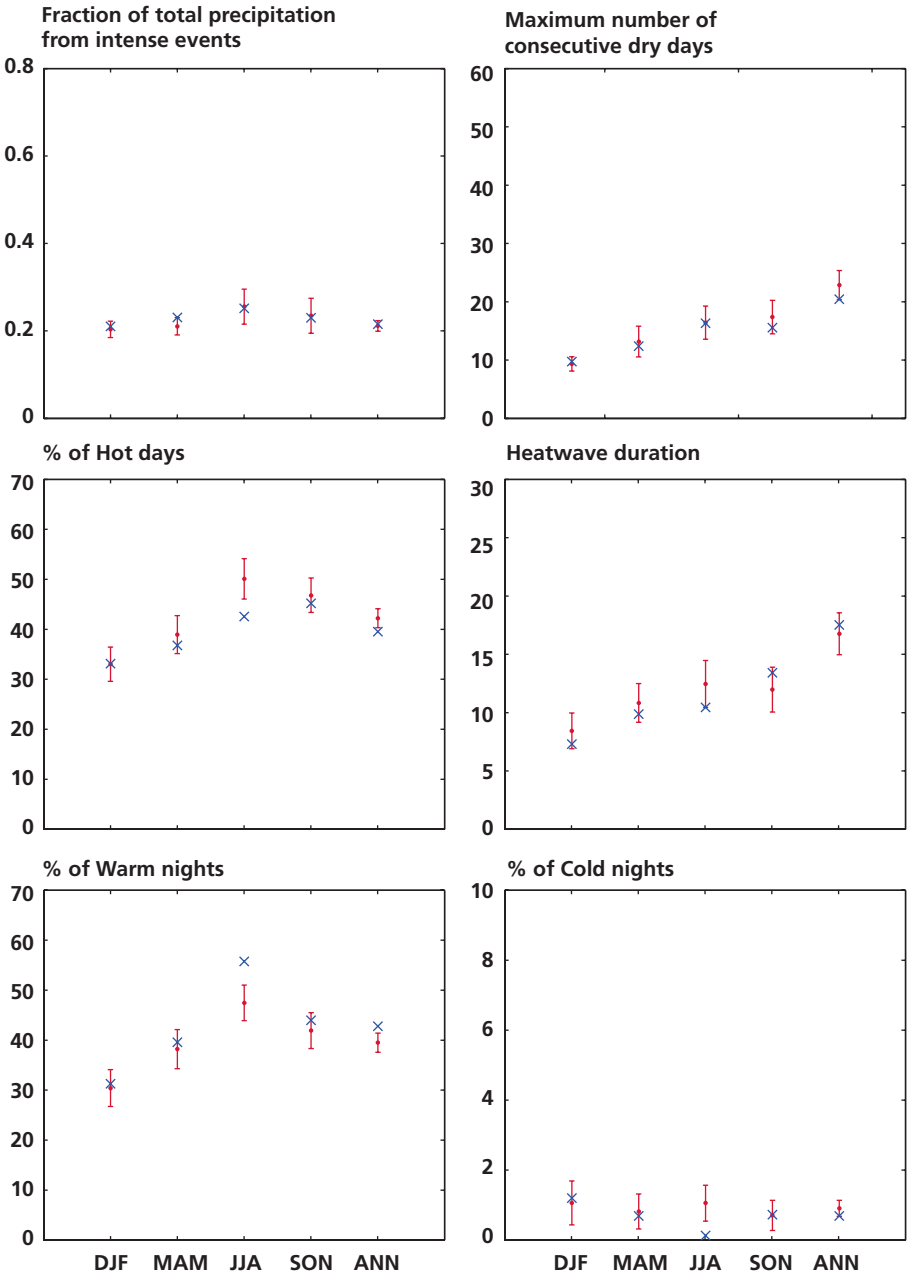

Figure 13(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Coltishall. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Coltishall

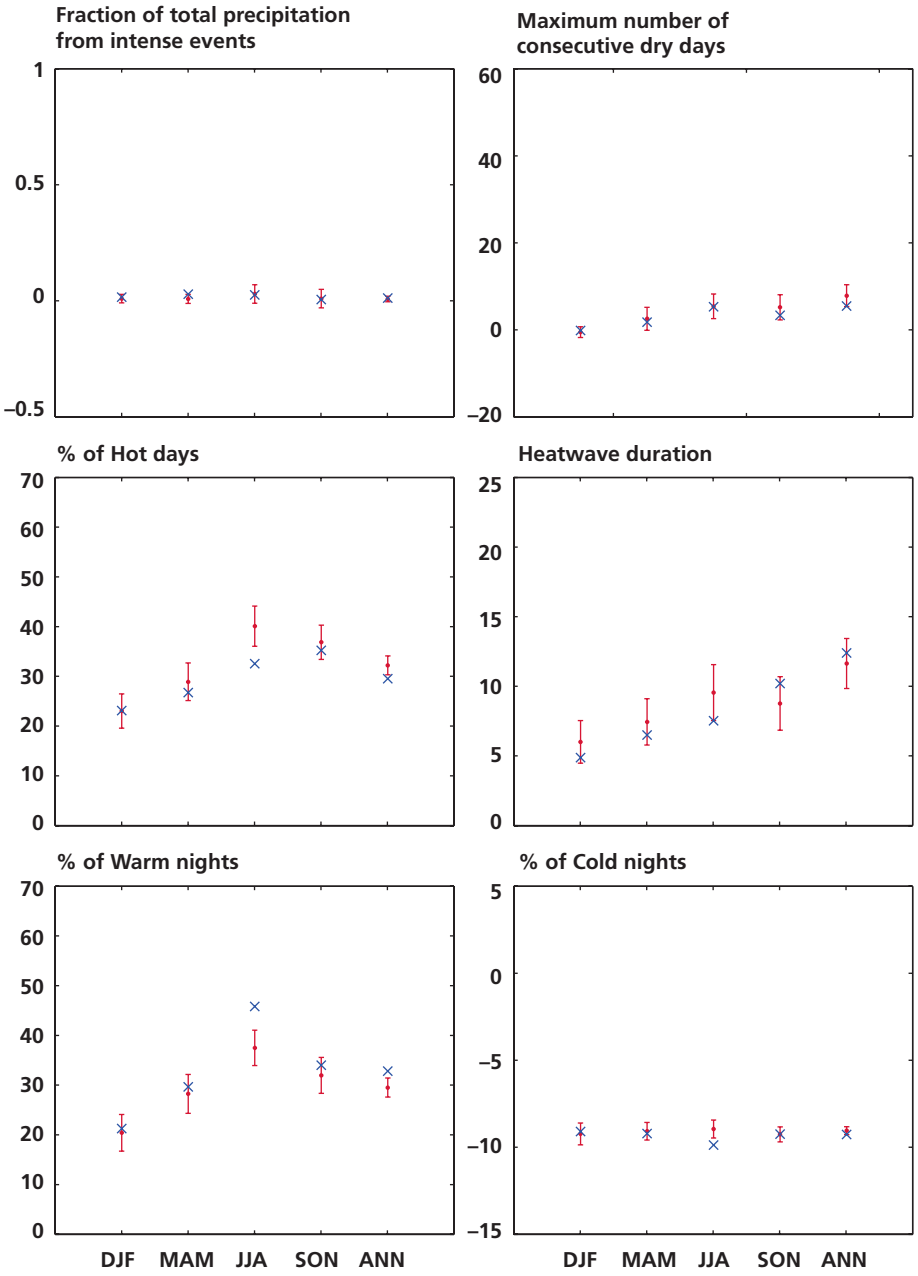

Figure 13(f): As Figure 13(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Dale Fort

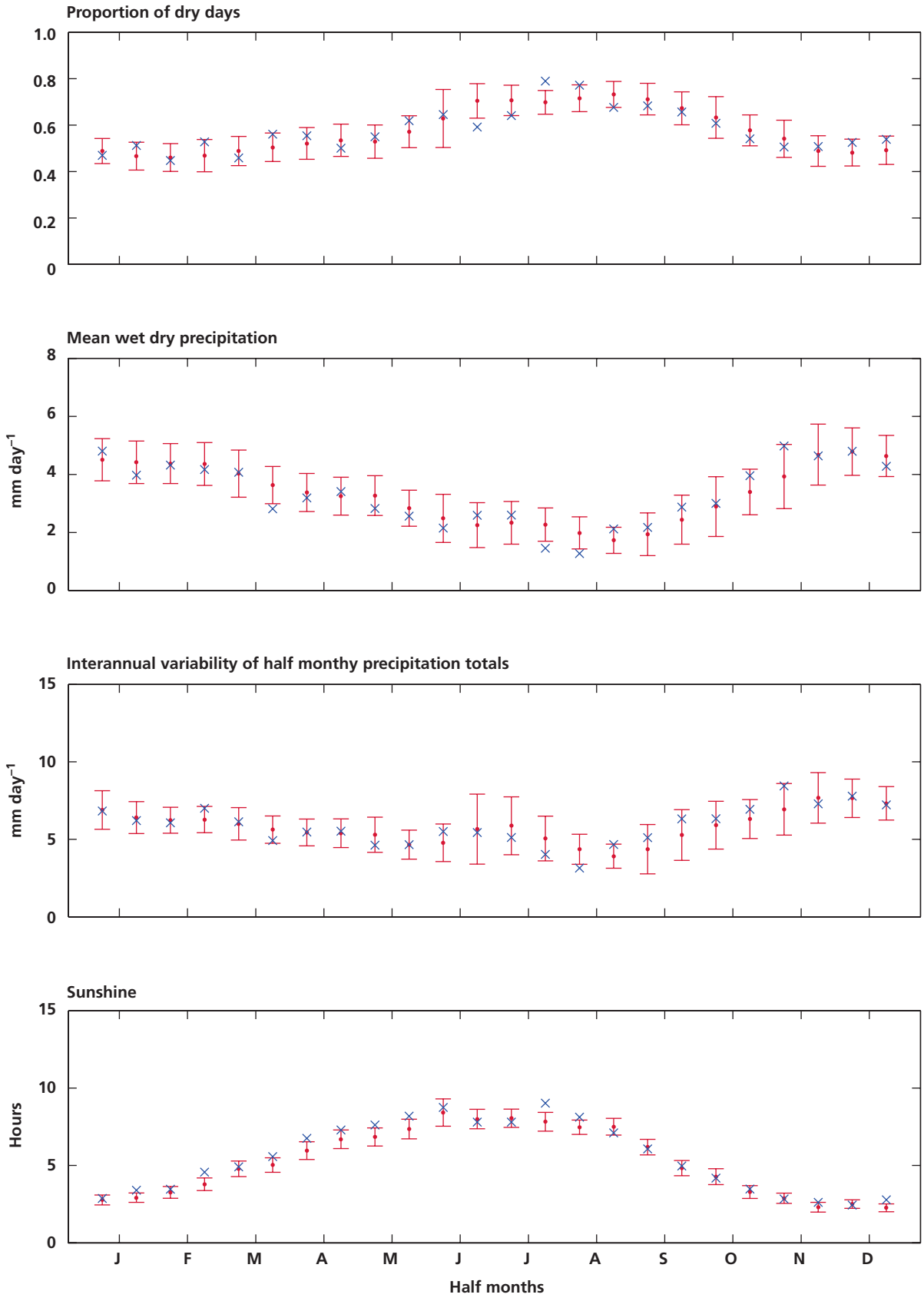

Figure 14(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Dale Fort. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Dale Fort

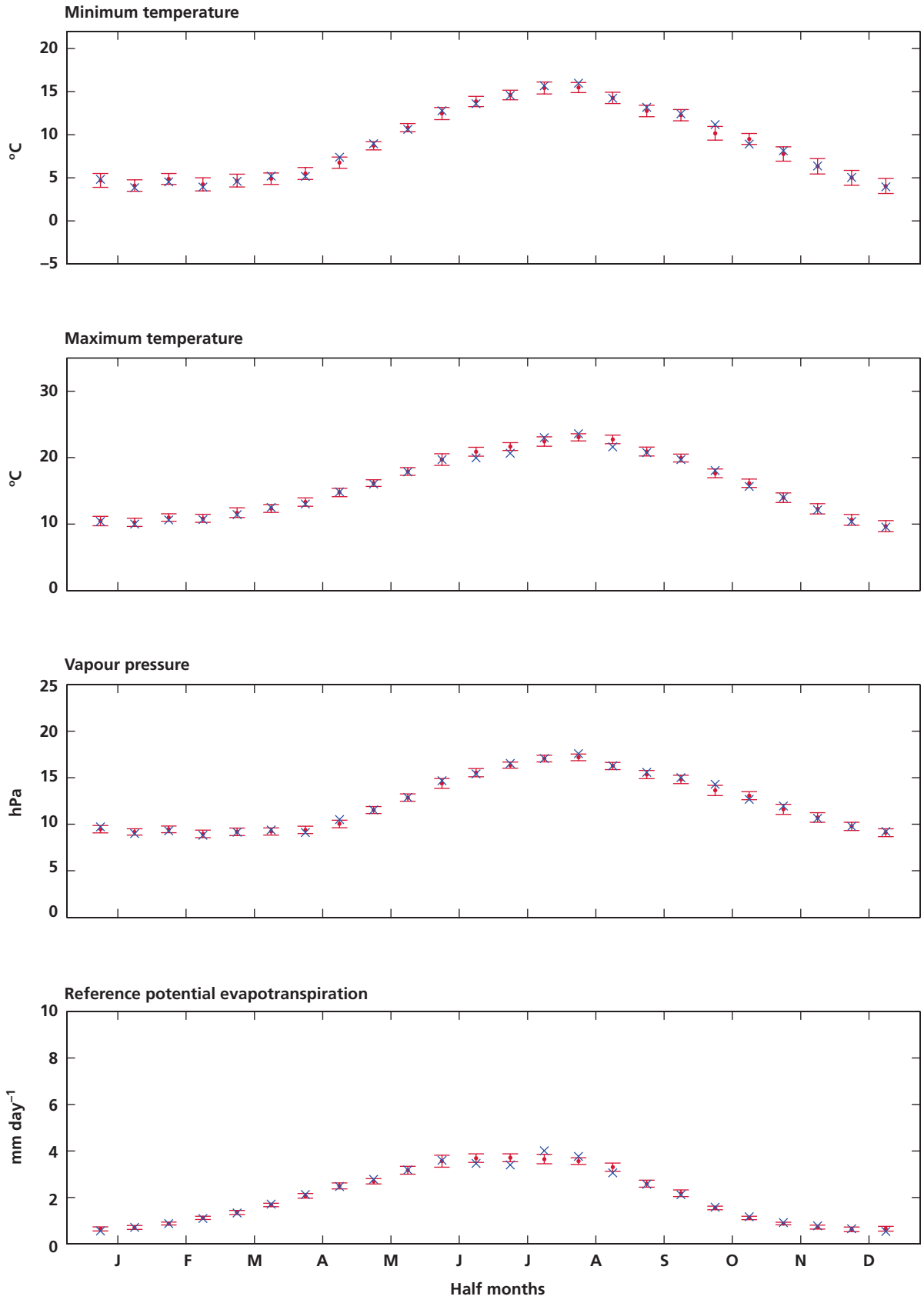

Figure 14(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Dale Fort. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Dale Fort

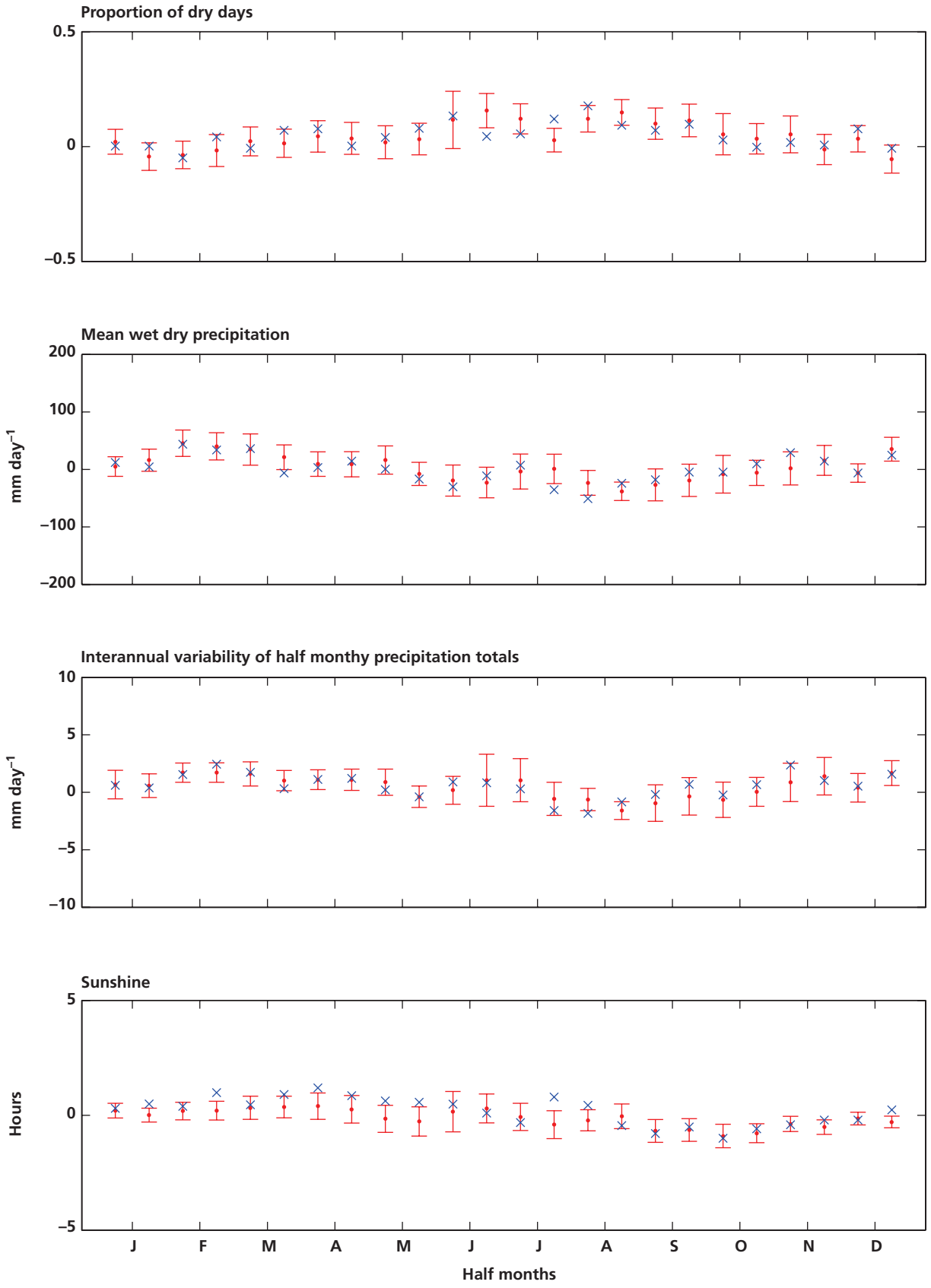

Figure 14(c): Figure 14(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Dale Fort

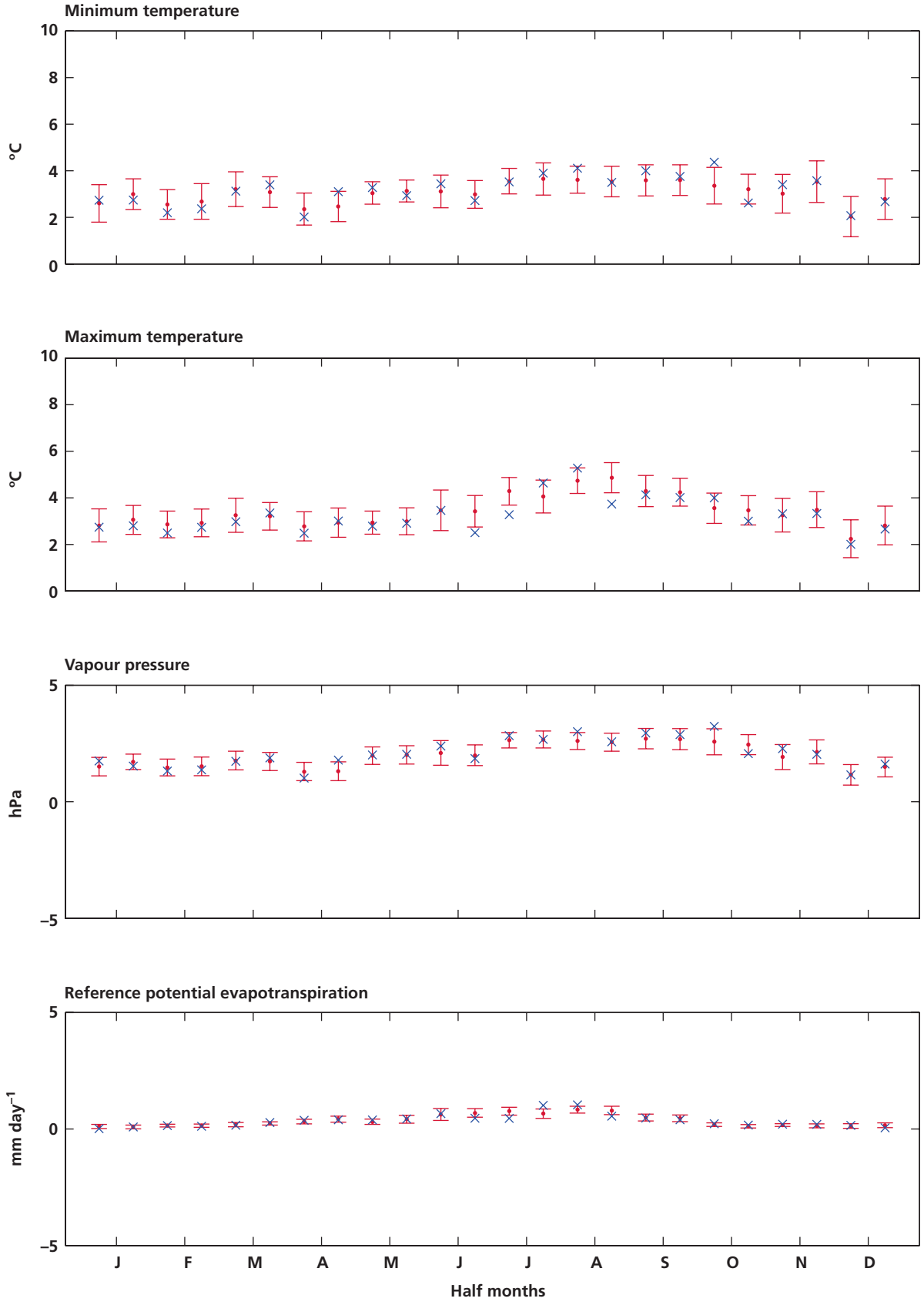

Figure 14(d): Figure 14(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Dale Fort

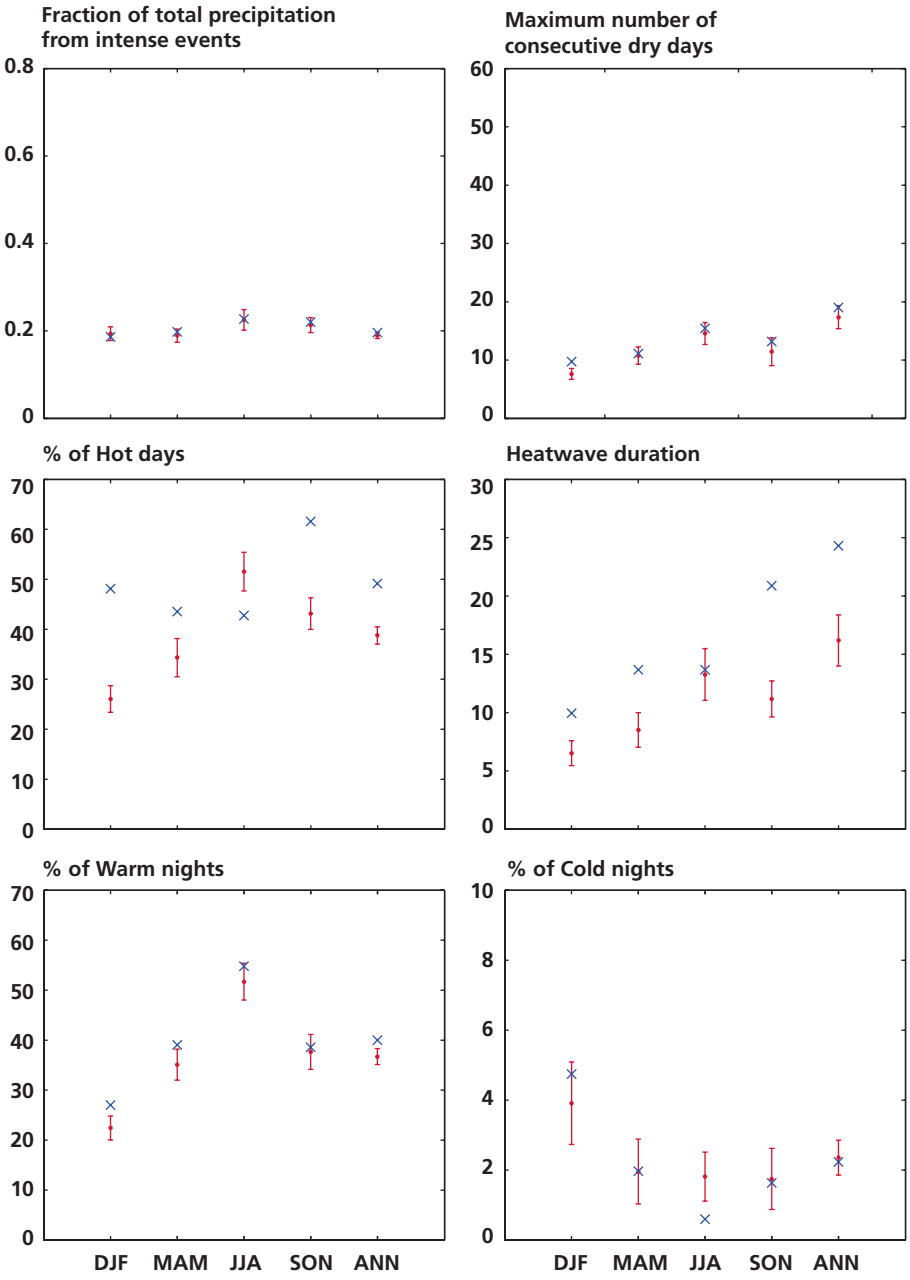

Figure 14(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Dale Fort. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Dale Fort

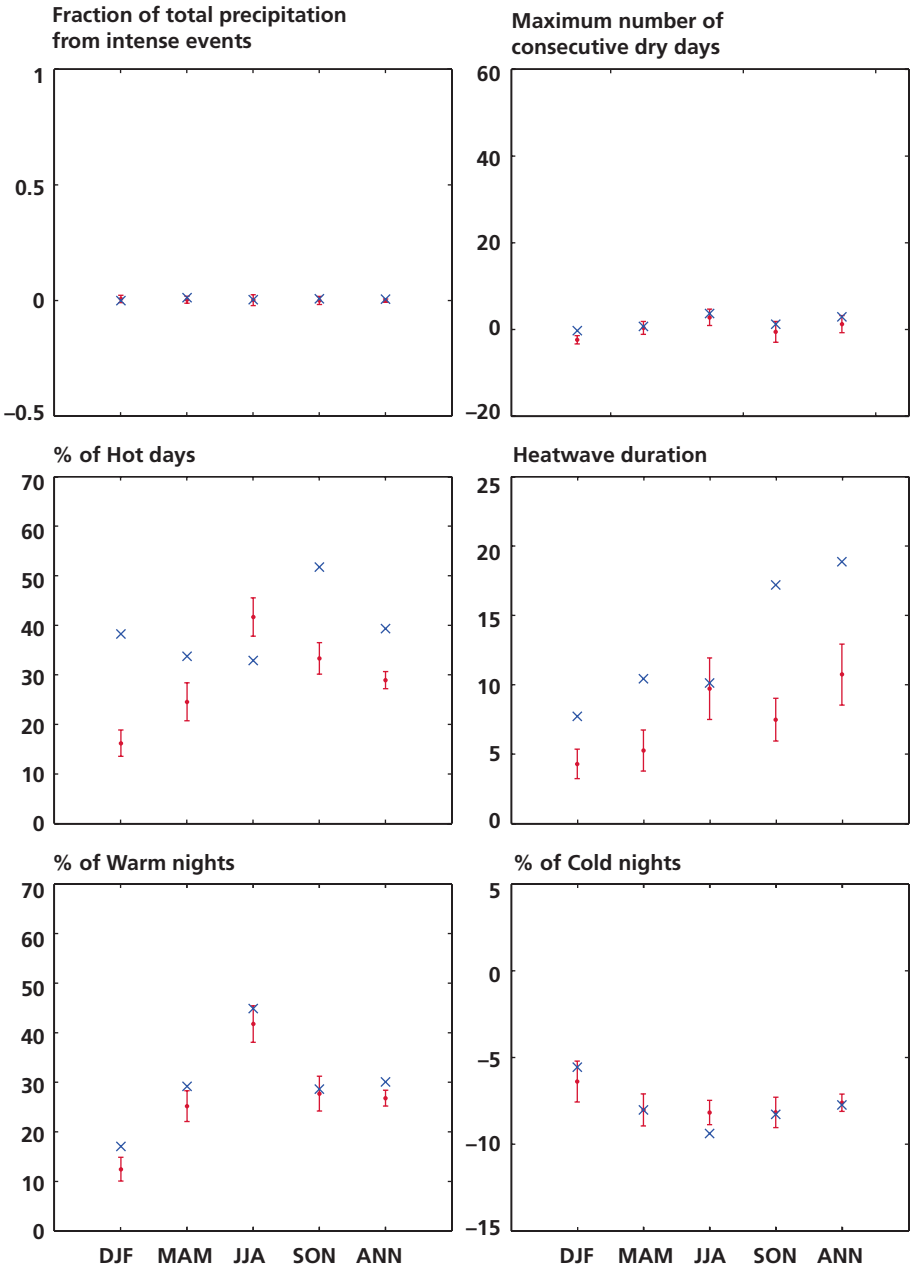

Figure 14(f): As Figure 14(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Eskdalemuir

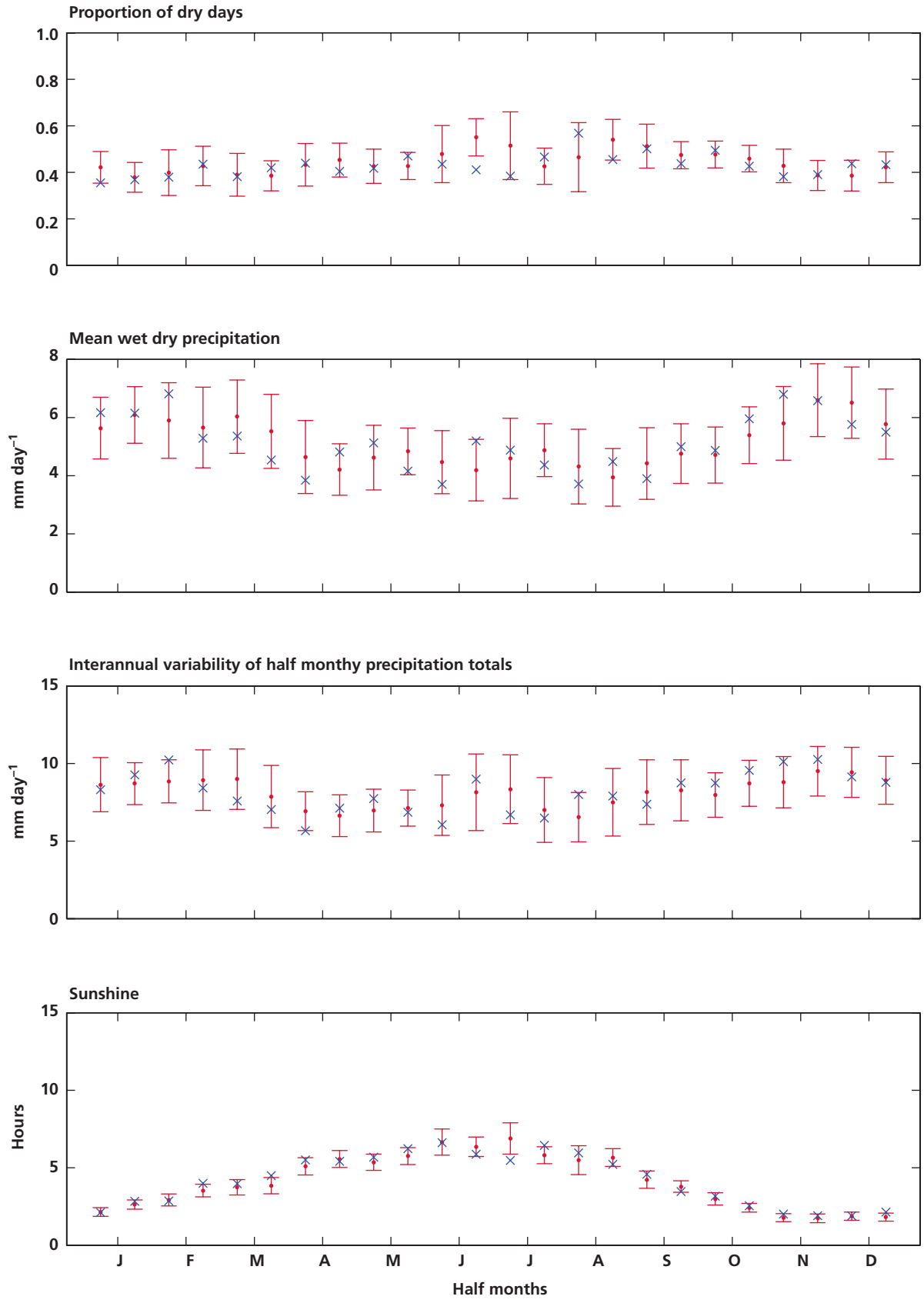

Figure 15(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Eskdalemuir. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Eskdalemuir

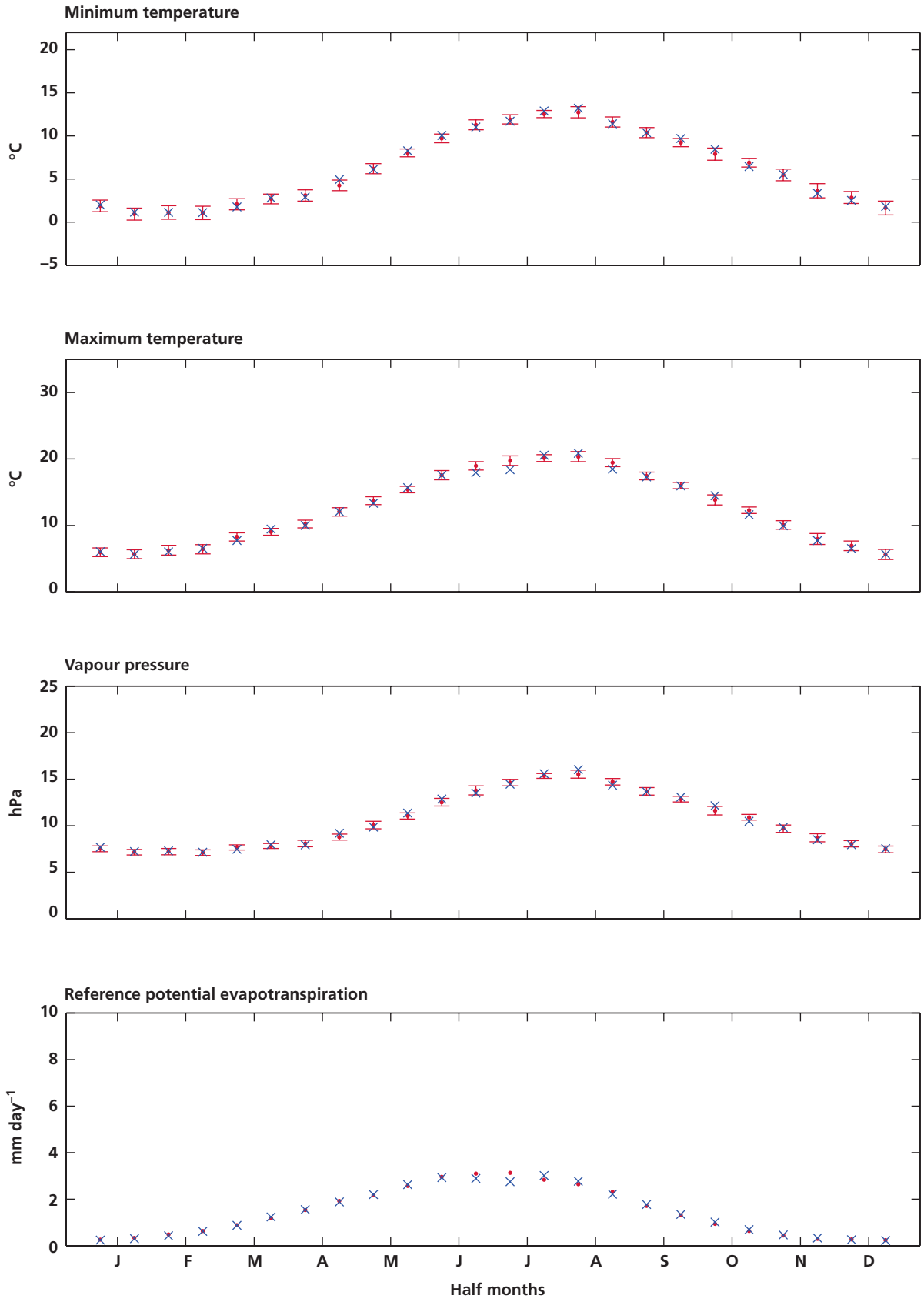

Figure 15(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Eskdalemuir. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Eskdalemuir

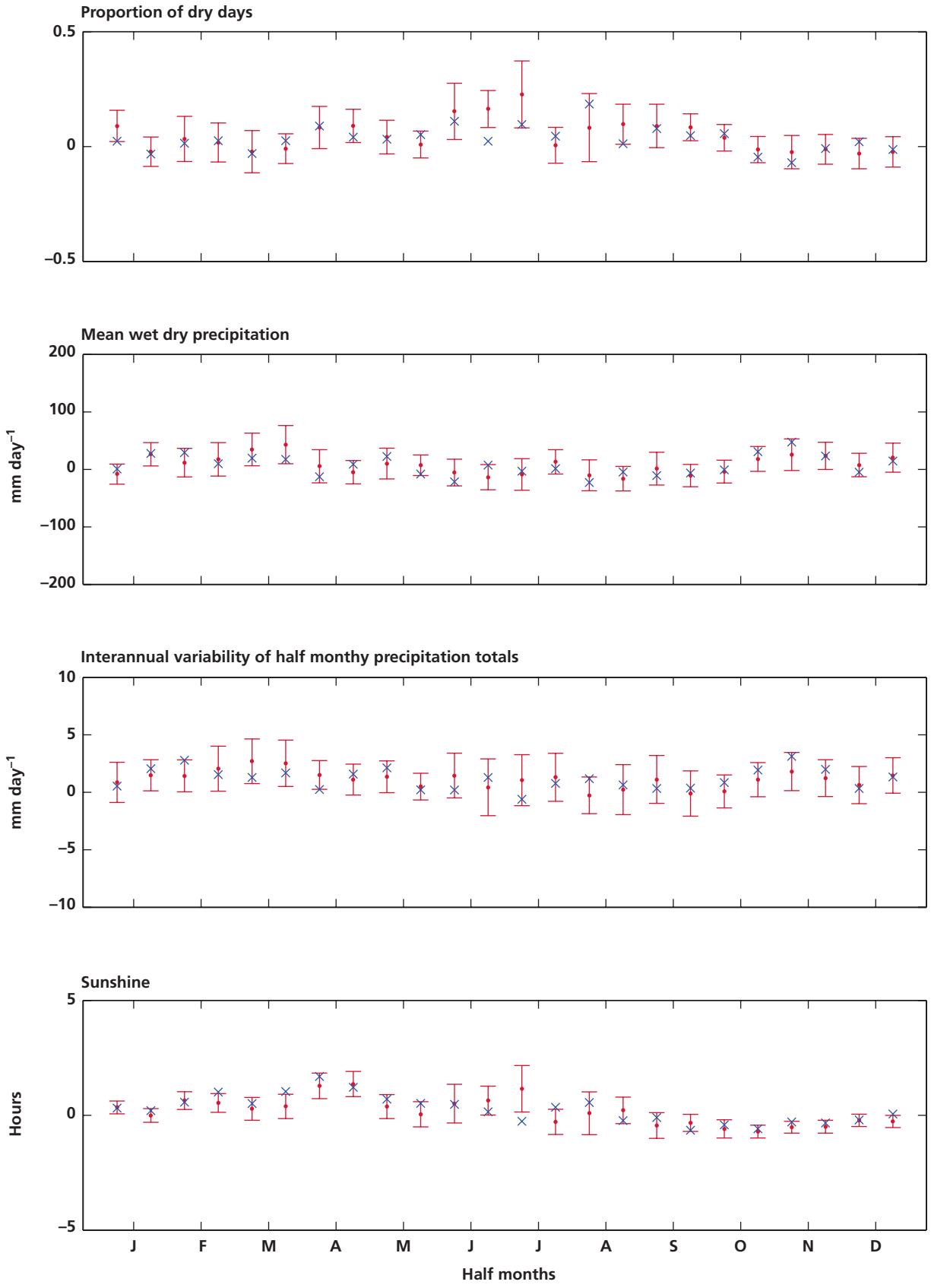

Figure 15(c): Figure 15(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Eskdalemuir

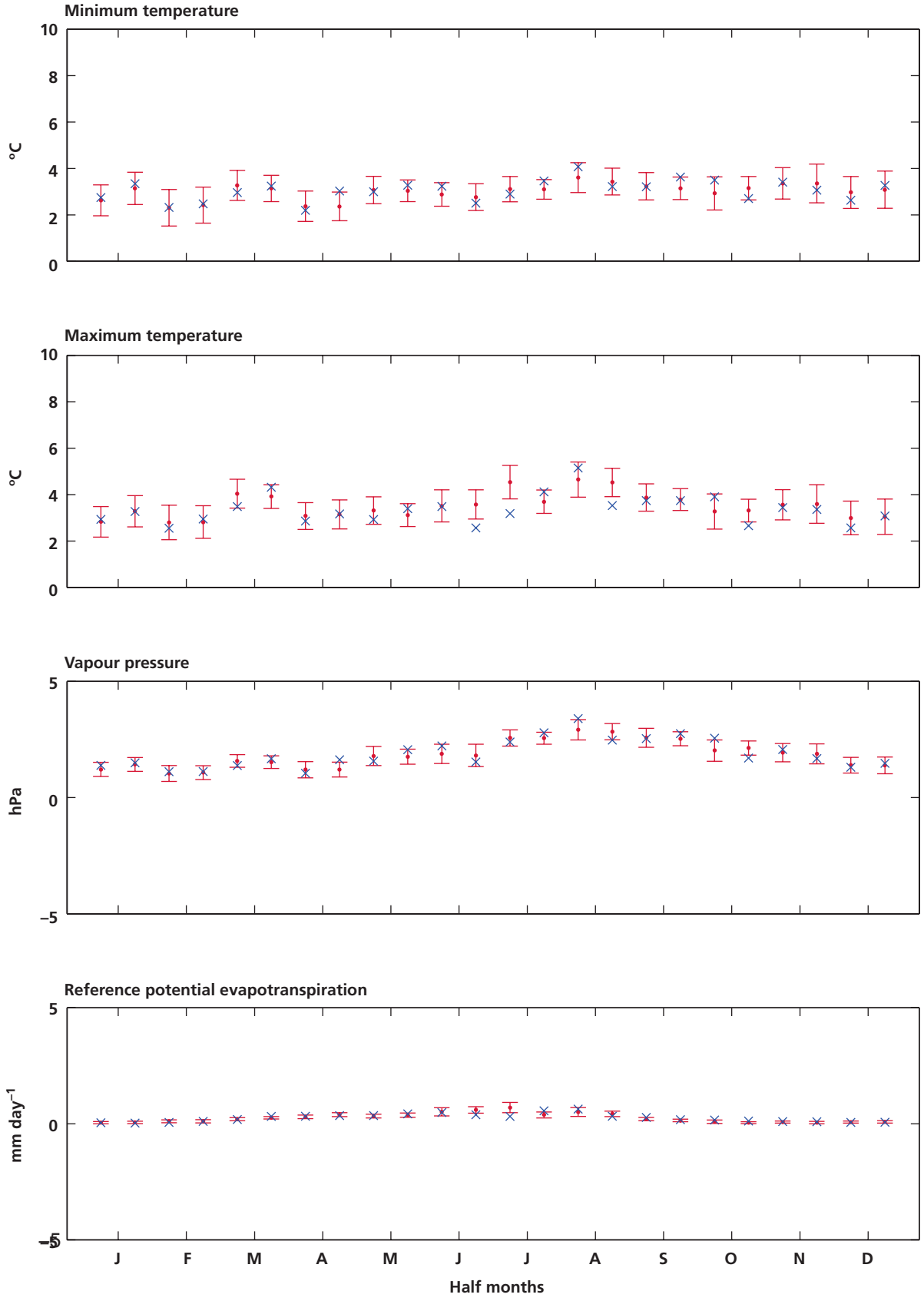

Figure 15(d): Figure 15(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Eskdalemuir

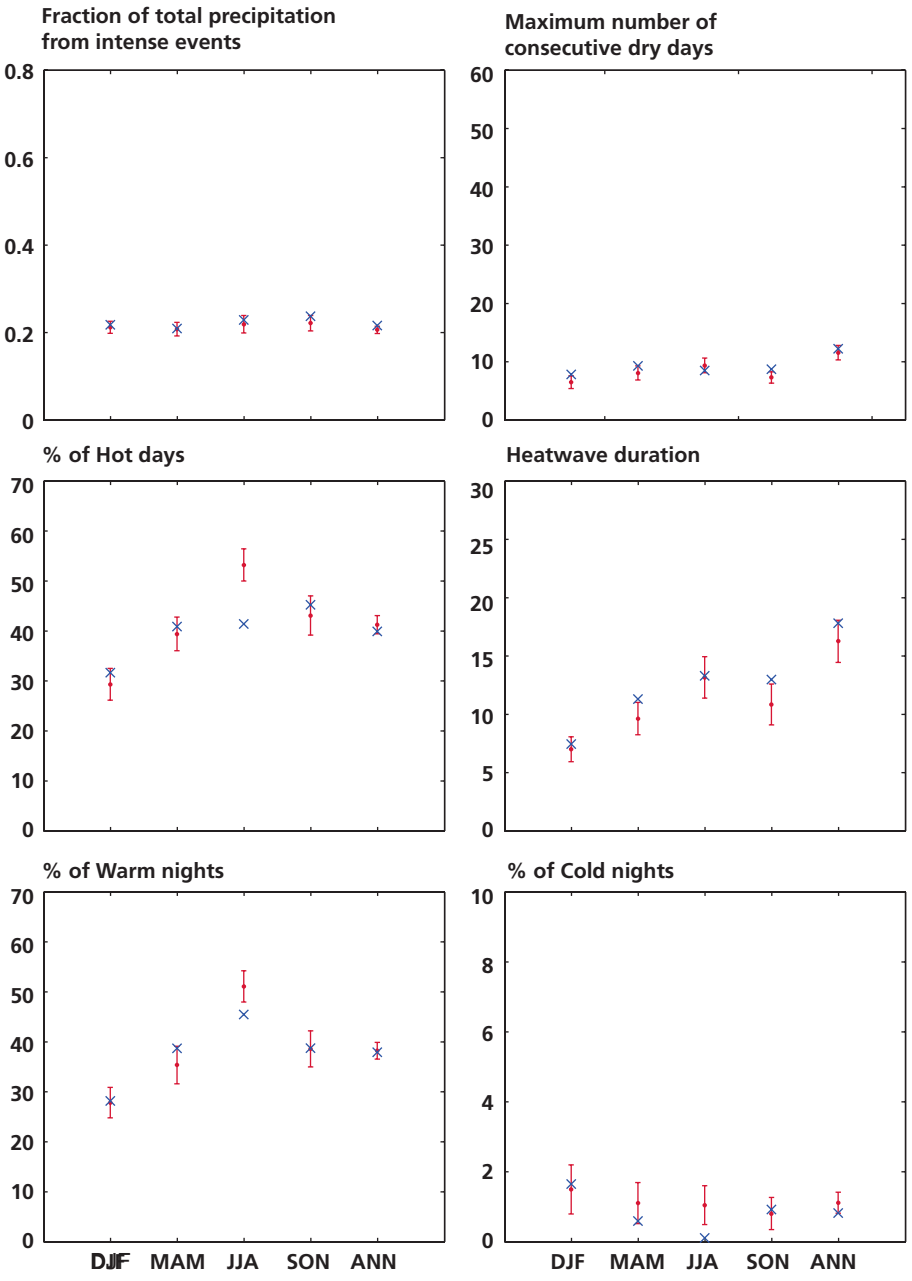

Figure 15(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Eskdalemuir. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Eskdalemuir

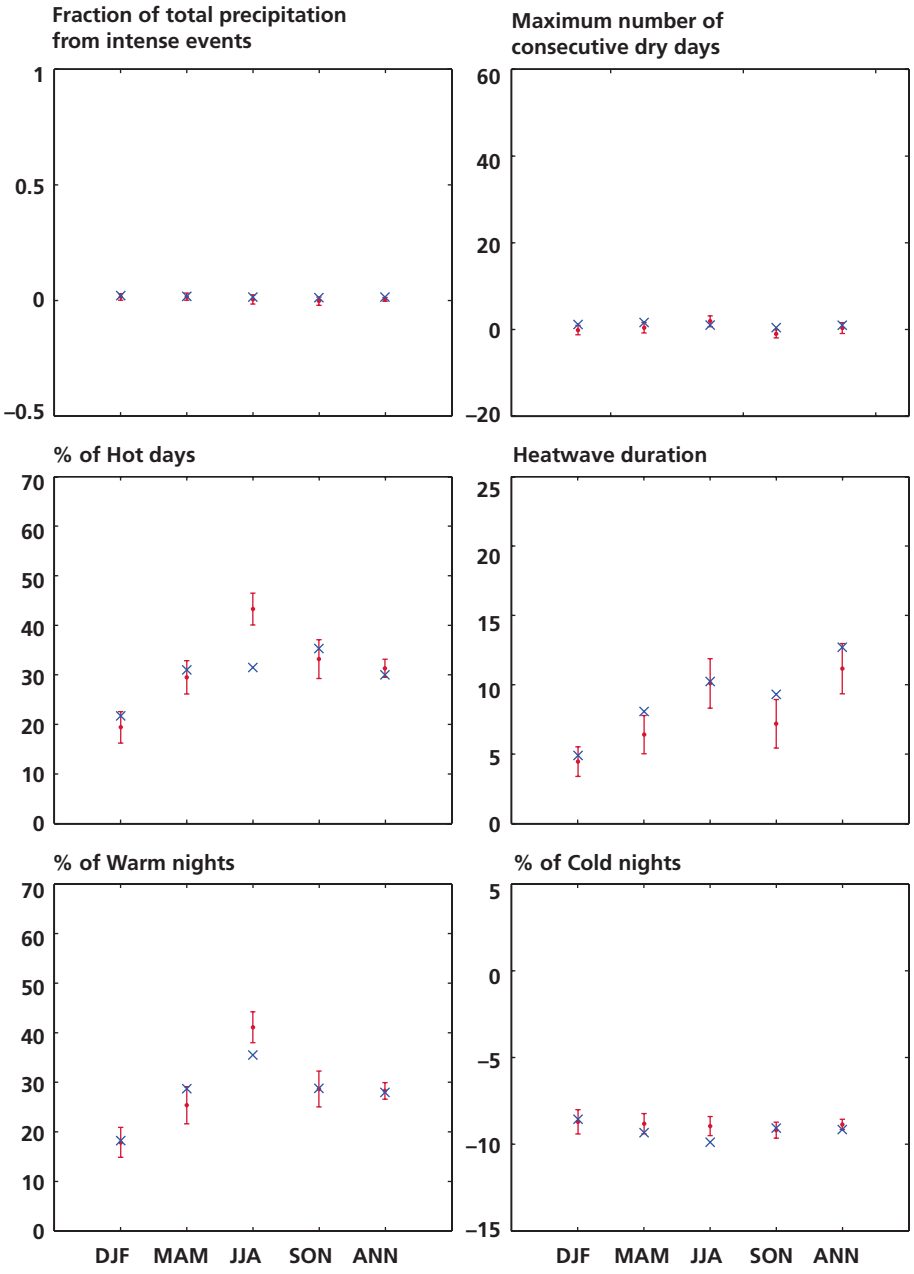

Figure 15(f): As Figure 15(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Heathrow

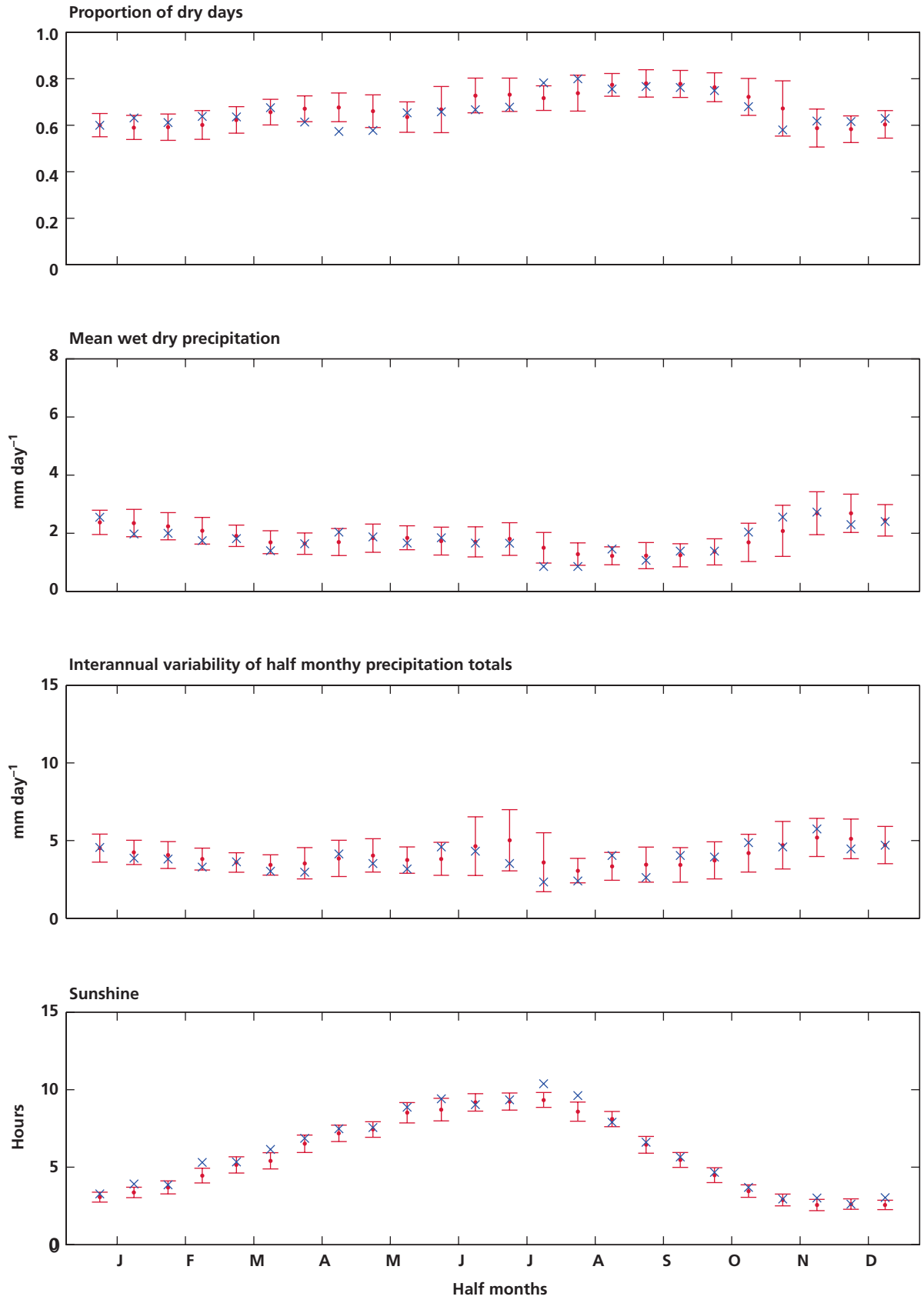

Figure 16(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Heathrow. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Heathrow

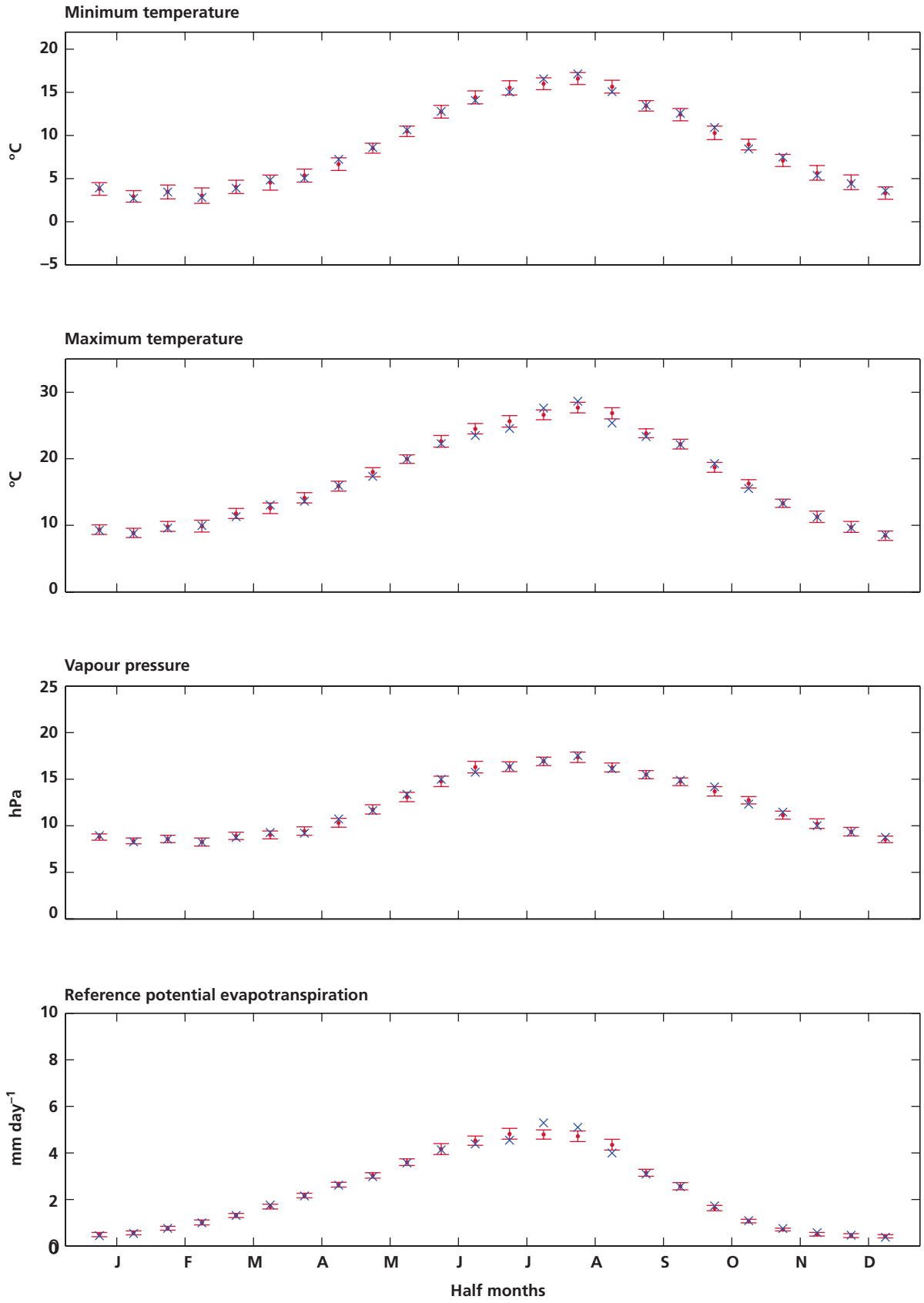

Figure 16(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Heathrow. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Heathrow

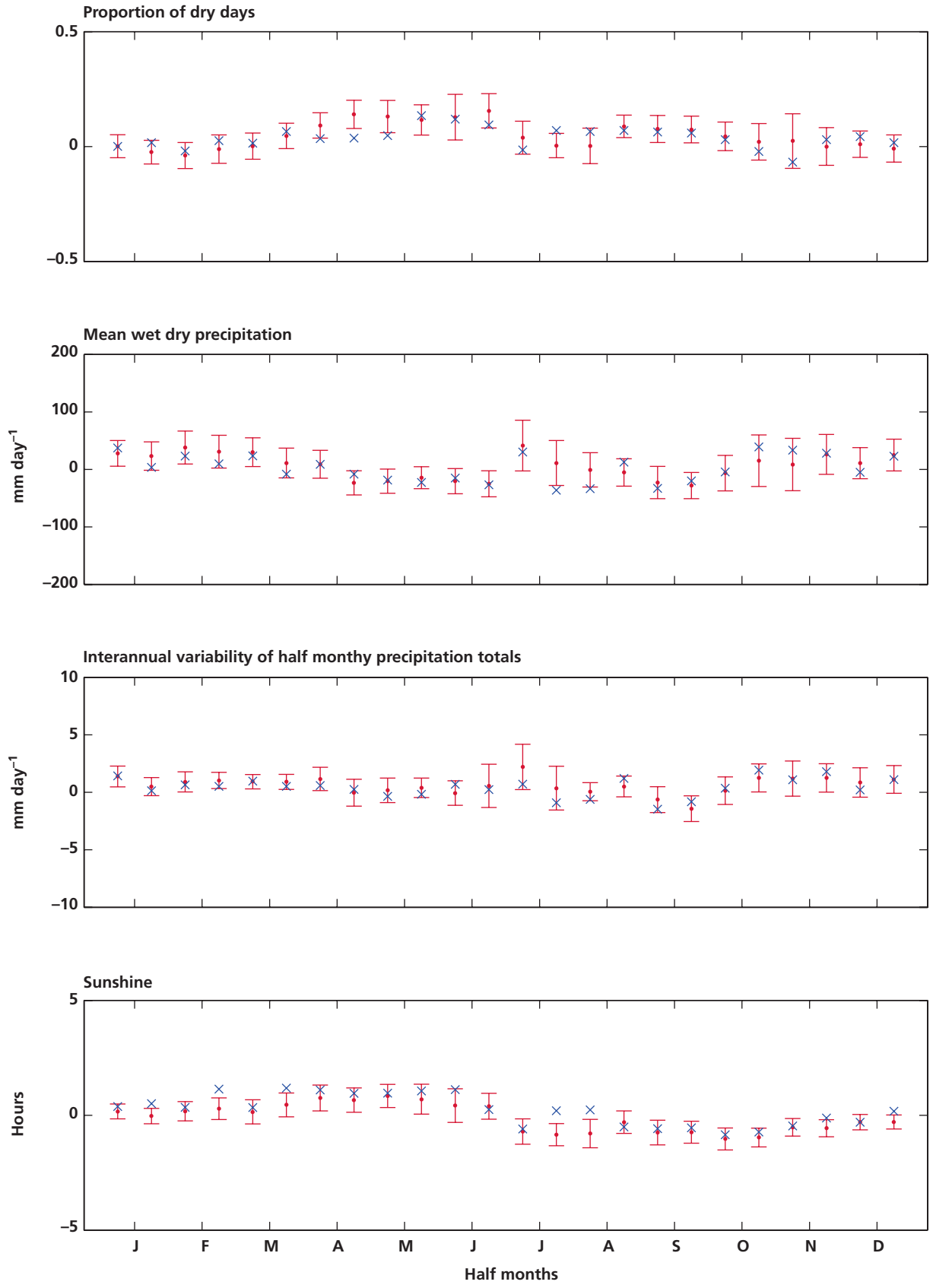

Figure 16(c): Figure 16(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Heathrow

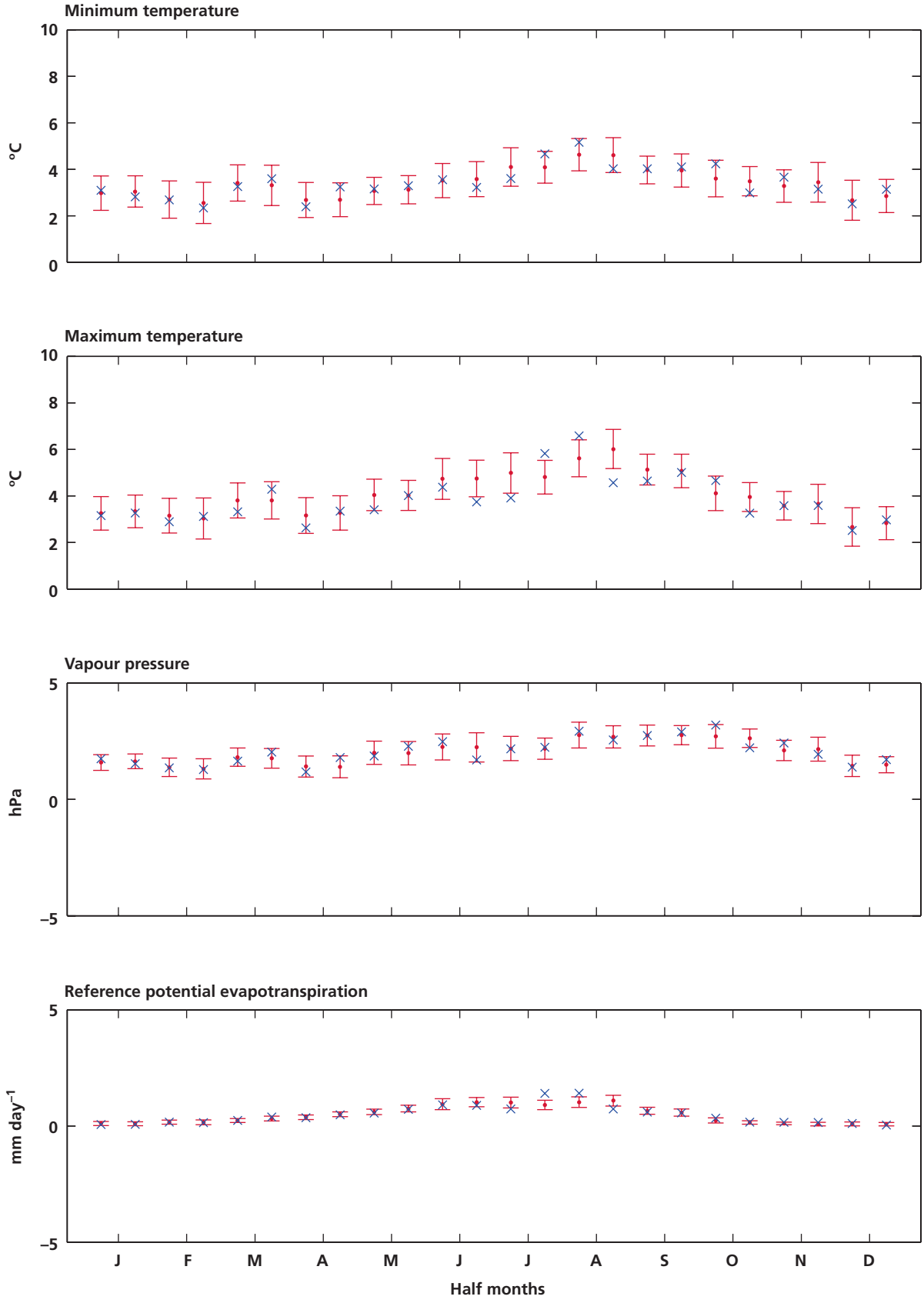

Figure 16(d): Figure 16(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Heathrow

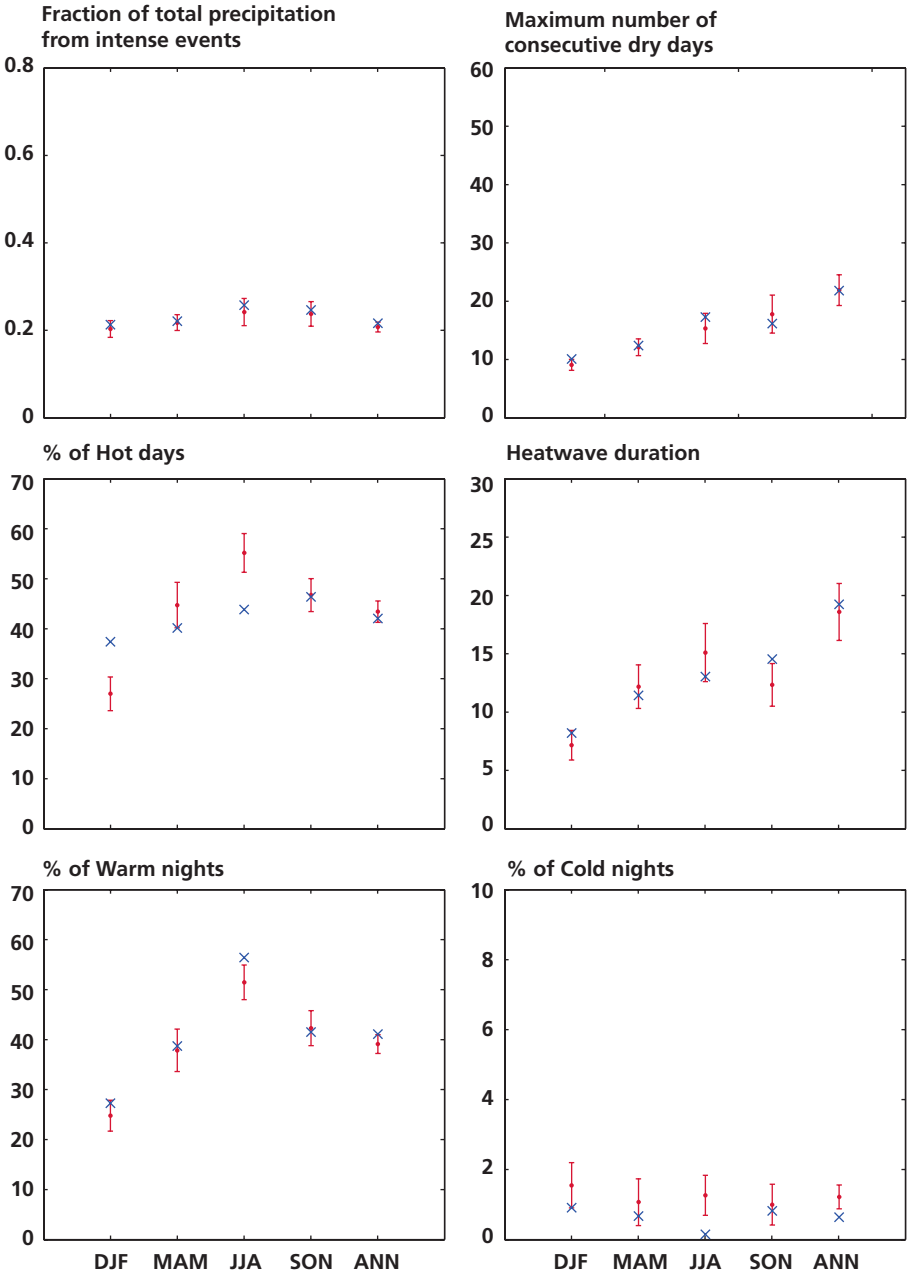

Figure 16(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Heathrow. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Heathrow

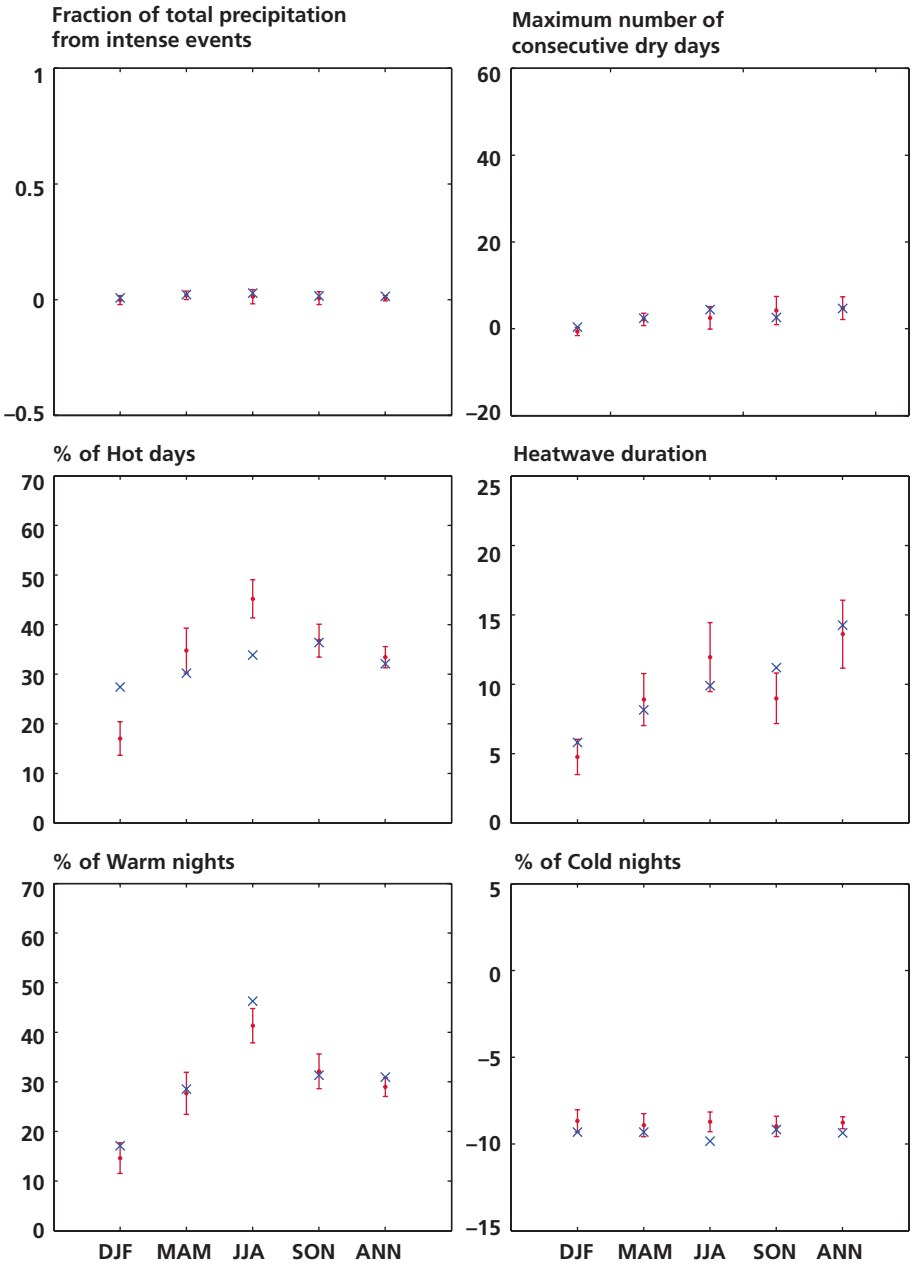

Figure 16(f): As Figure 16(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Paisley

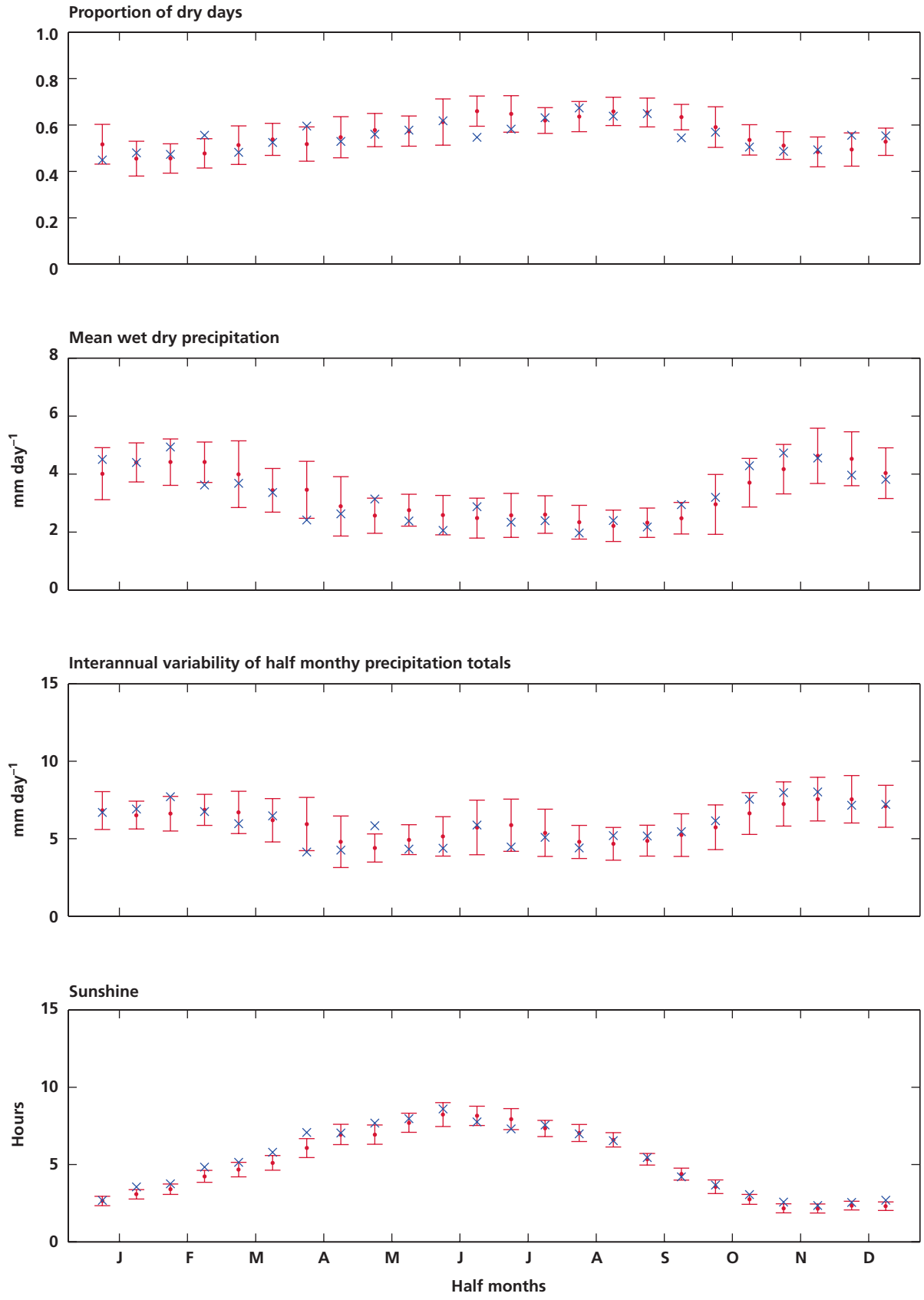

Figure 17(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Paisley. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Paisley

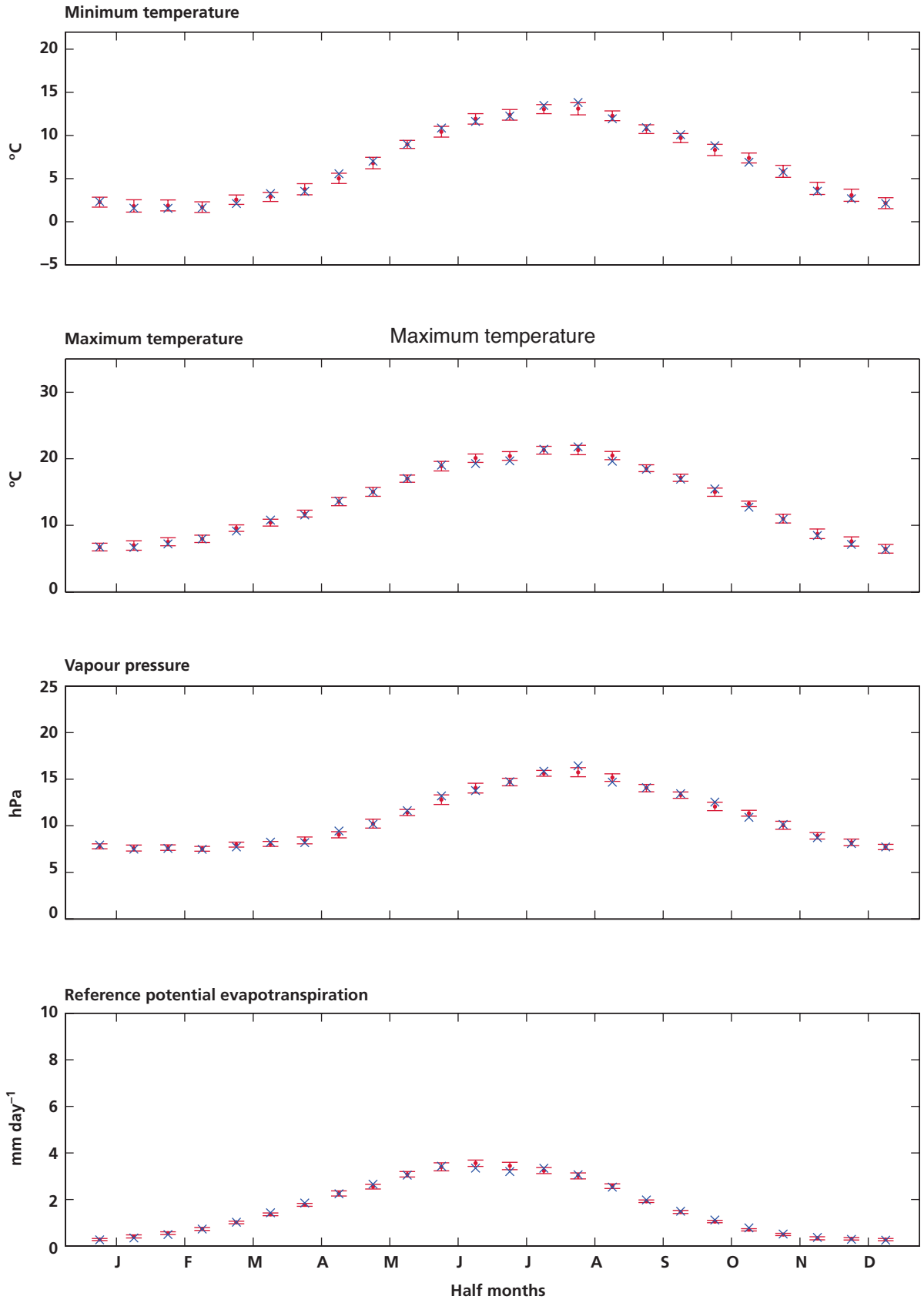

Figure 17(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Paisley. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Paisley

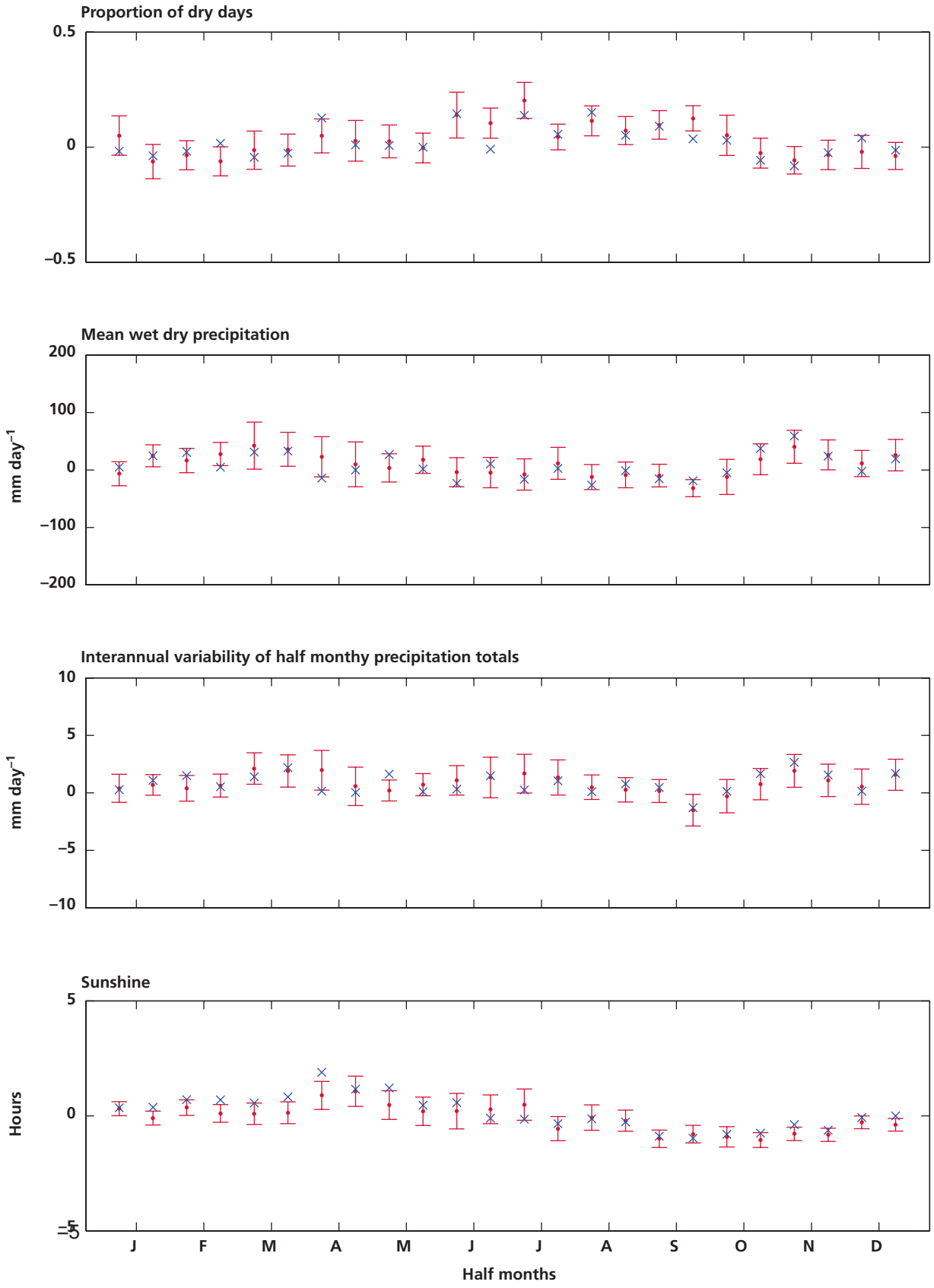

Figure 17(c): Figure 17(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Paisley

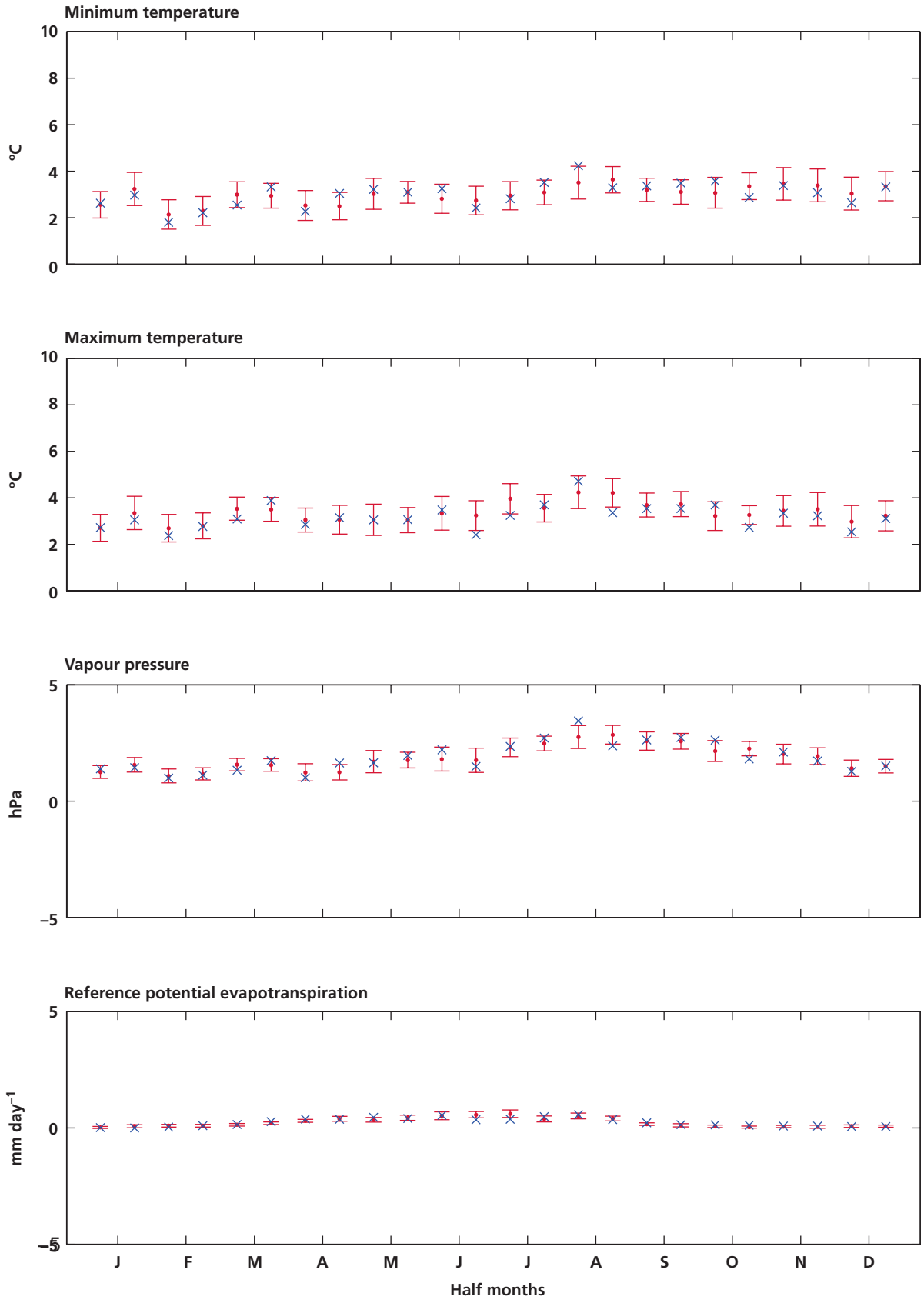

Figure 17(d): Figure 17(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Paisley

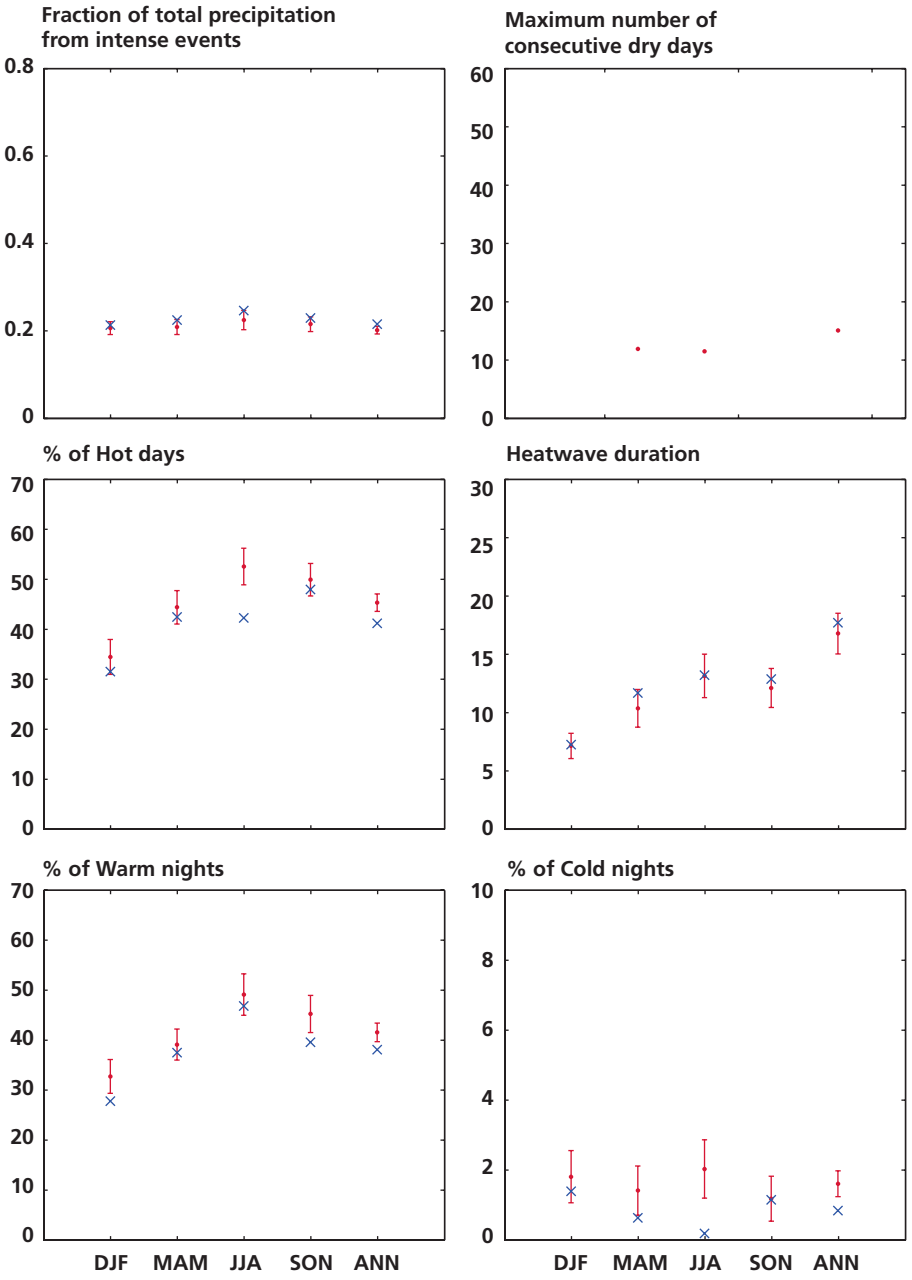

Figure 17(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Paisley. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Paisley

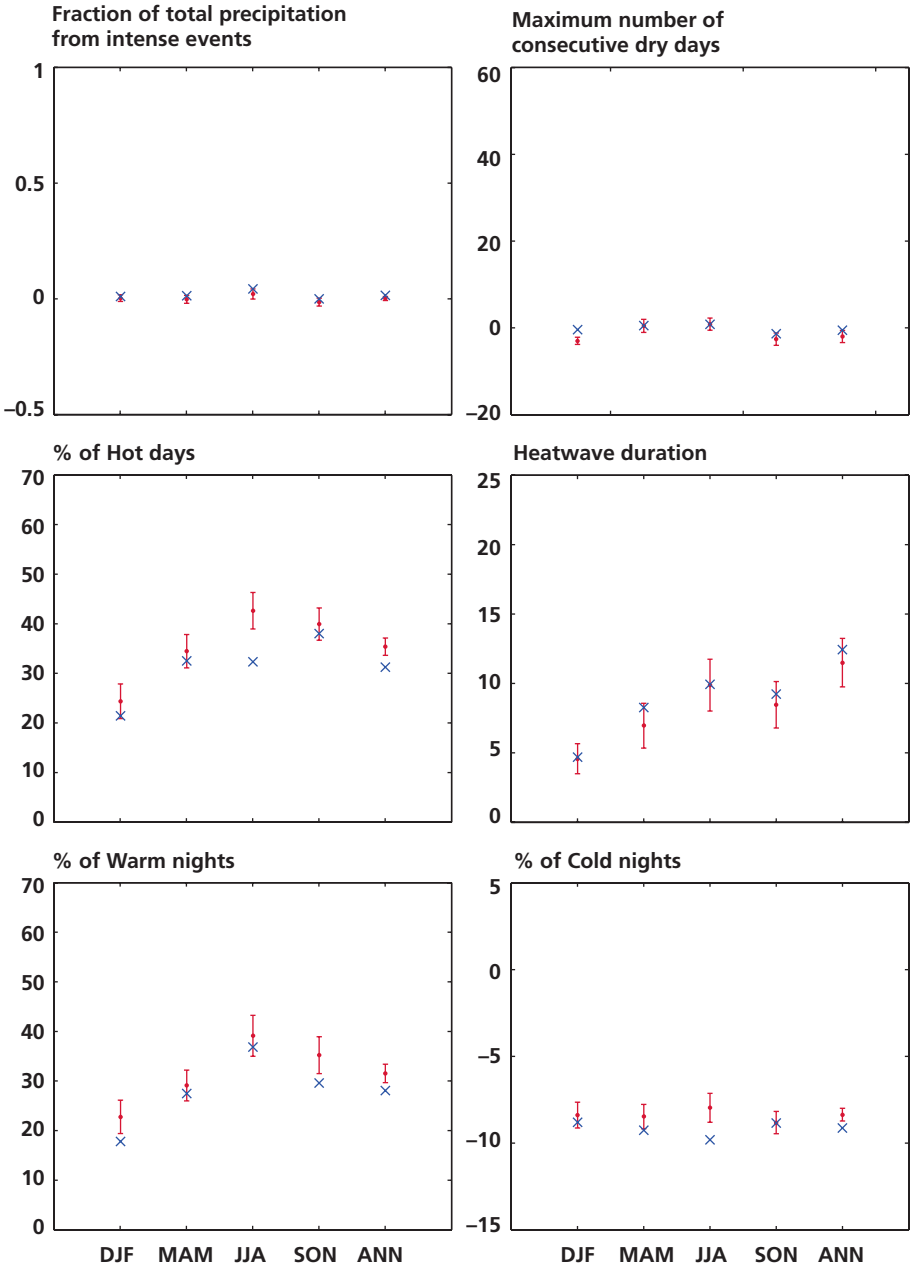

Figure 17(f): As Figure 17(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Ringway

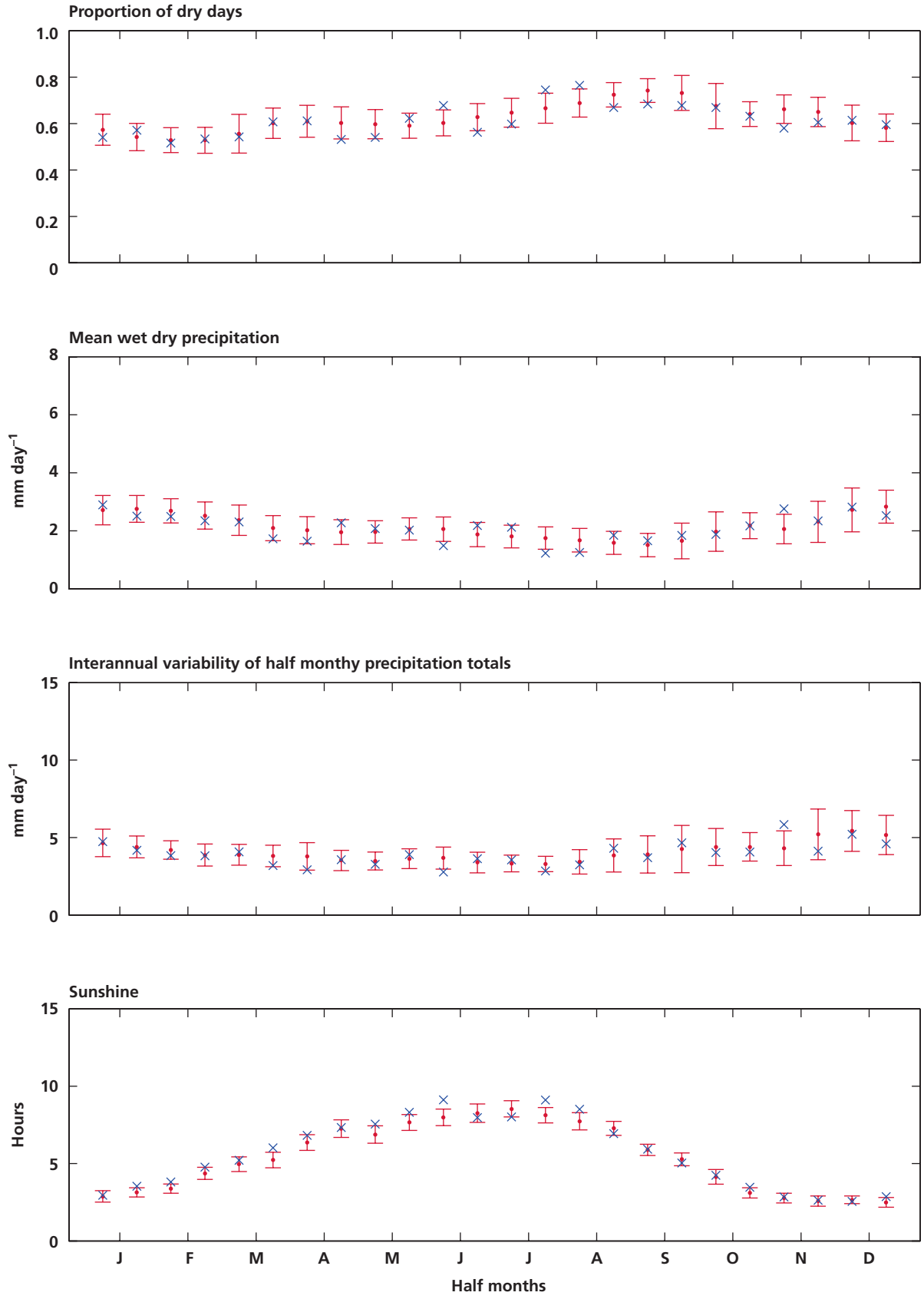

Figure 18(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Ringway. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Ringway

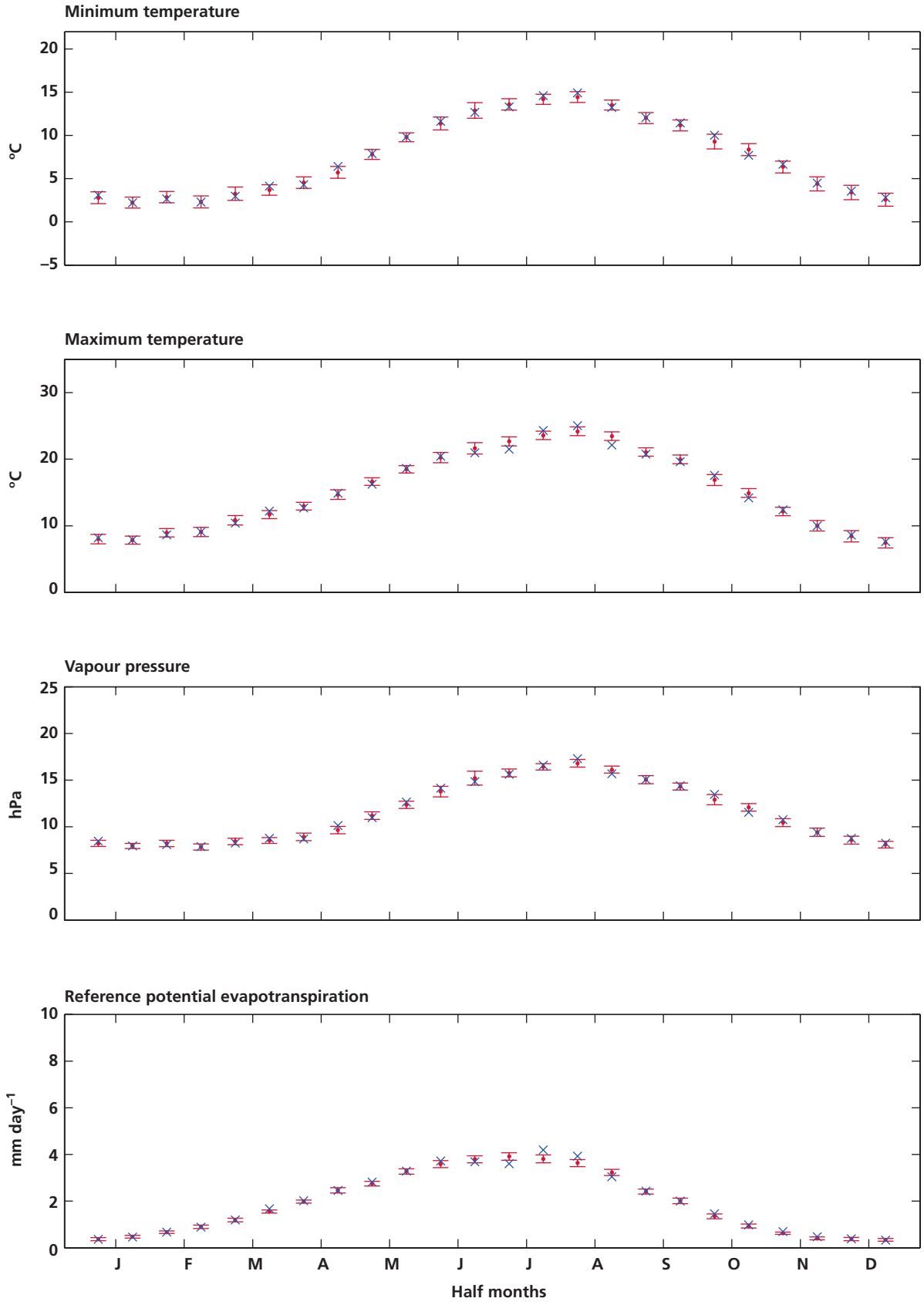

Figure 18(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Ringway. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Ringway

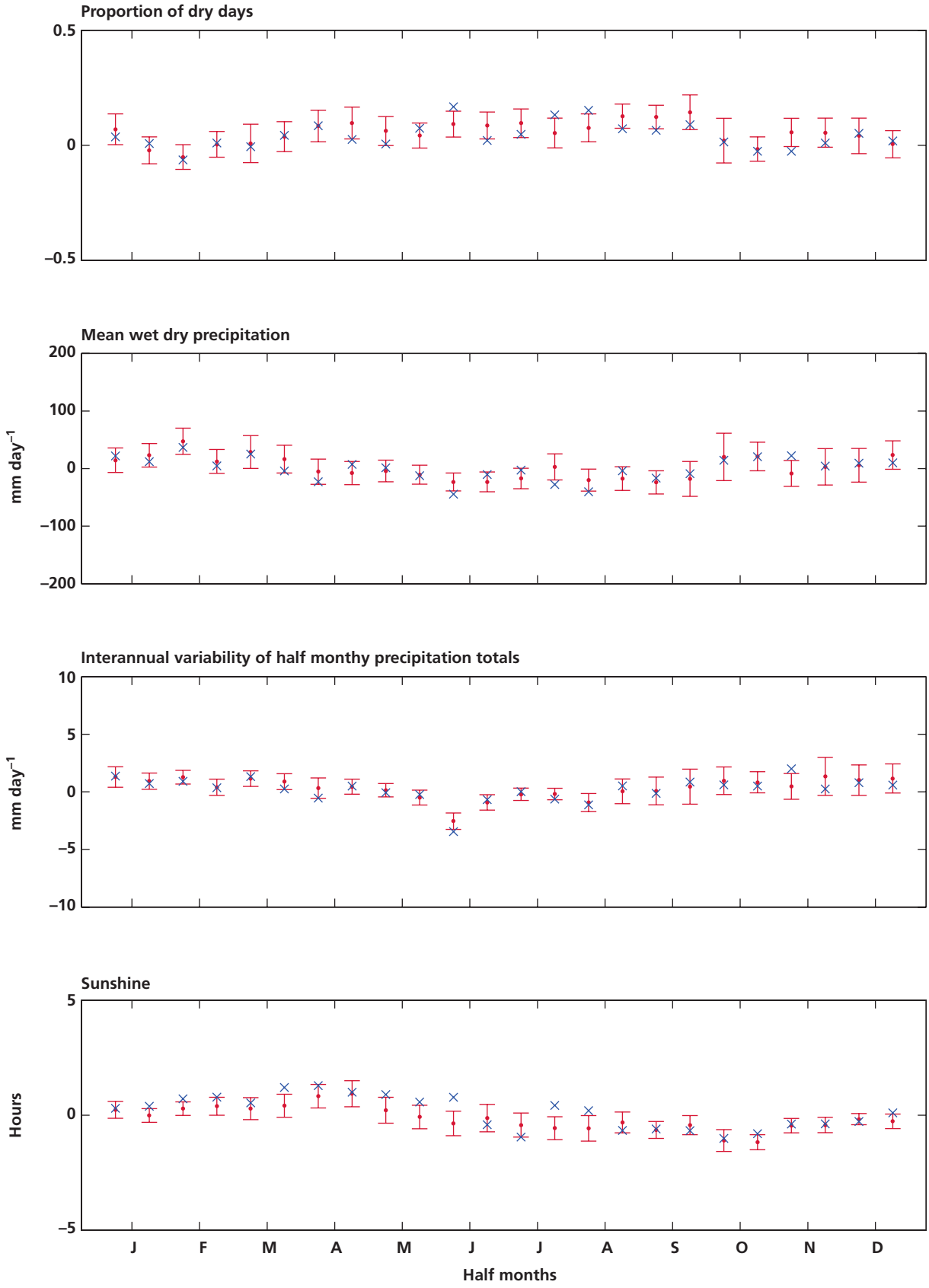

Figure 18(c): Figure 18(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Ringway

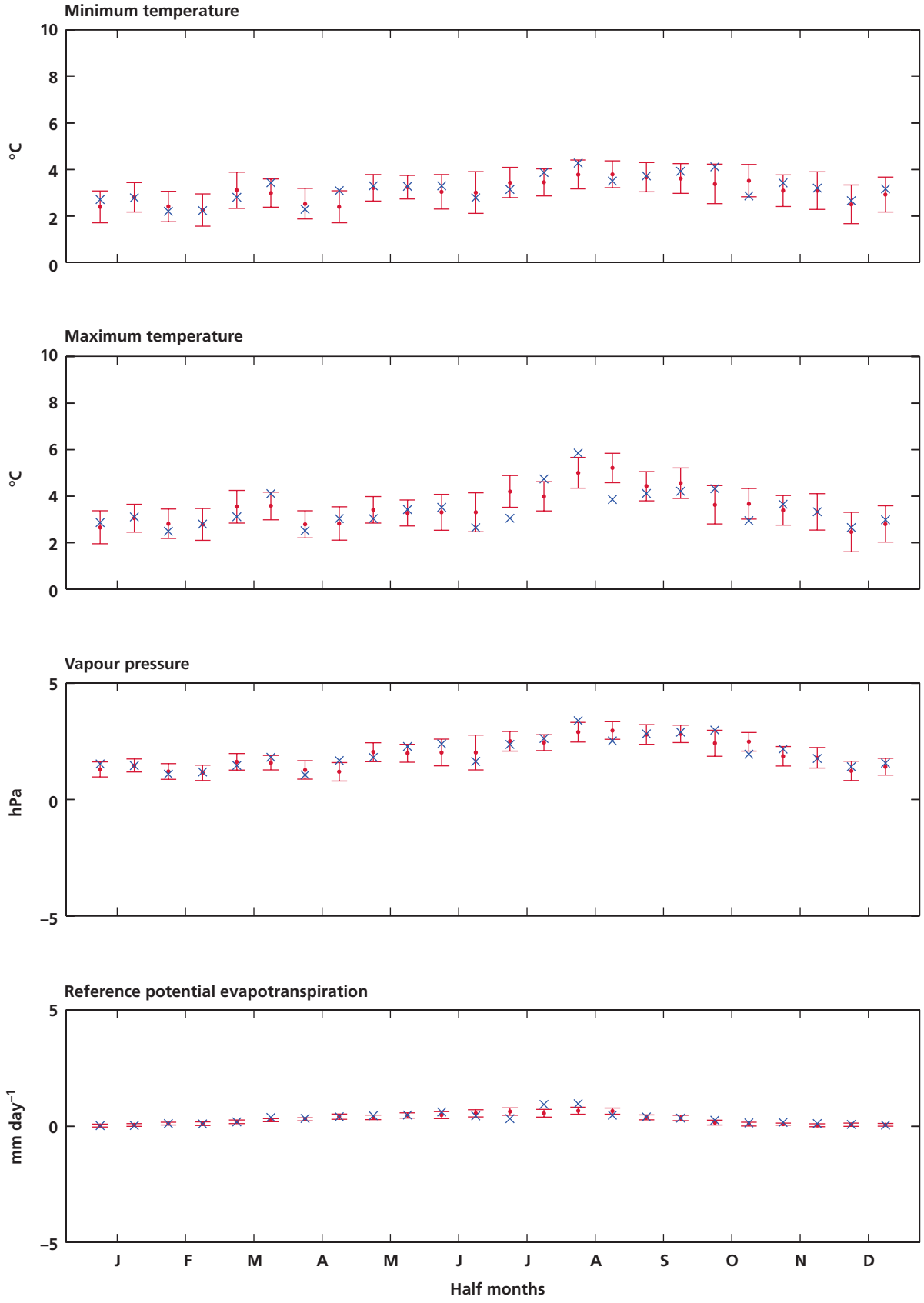

Figure 18(d): Figure 18(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Ringway

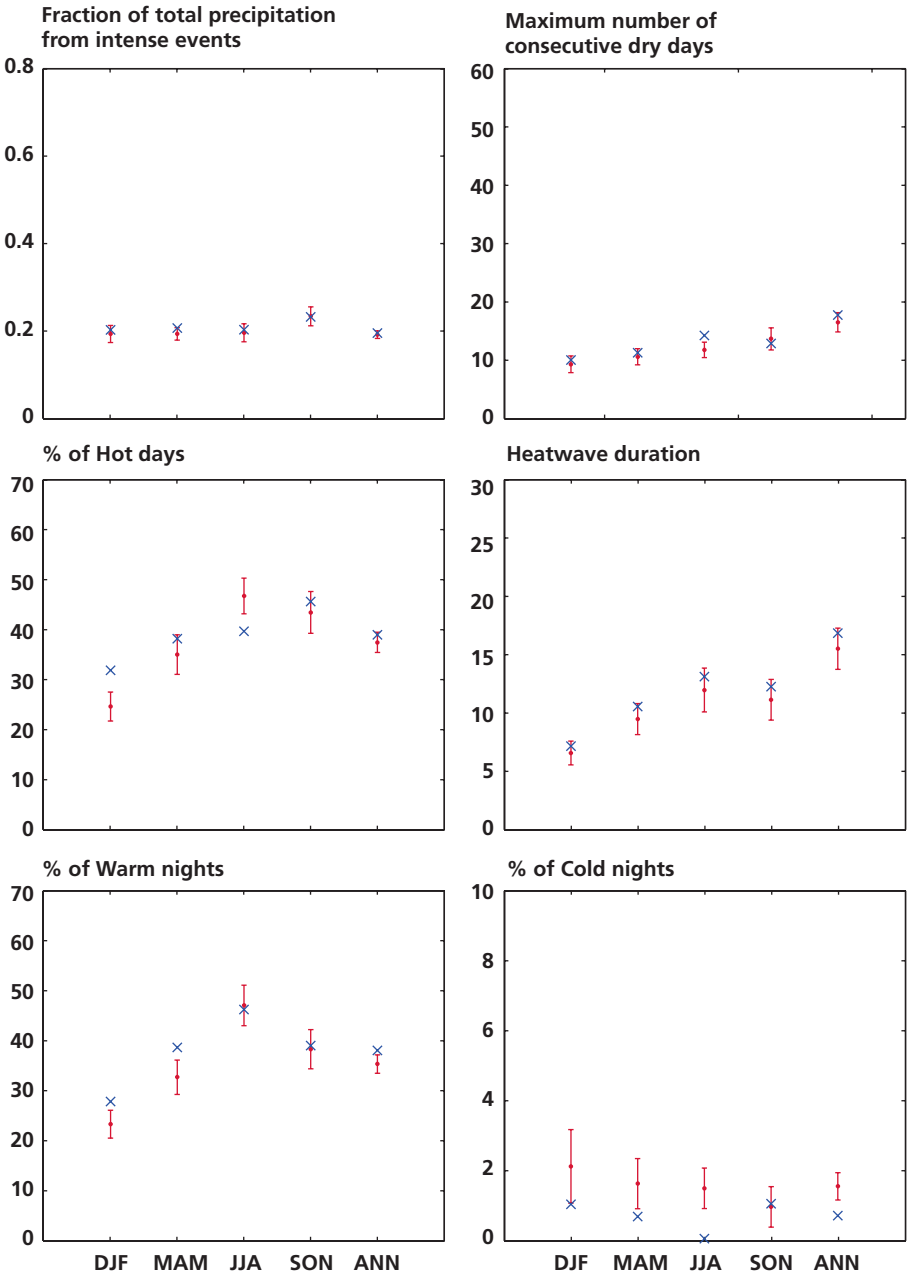

Figure 18(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Ringway. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Ringway

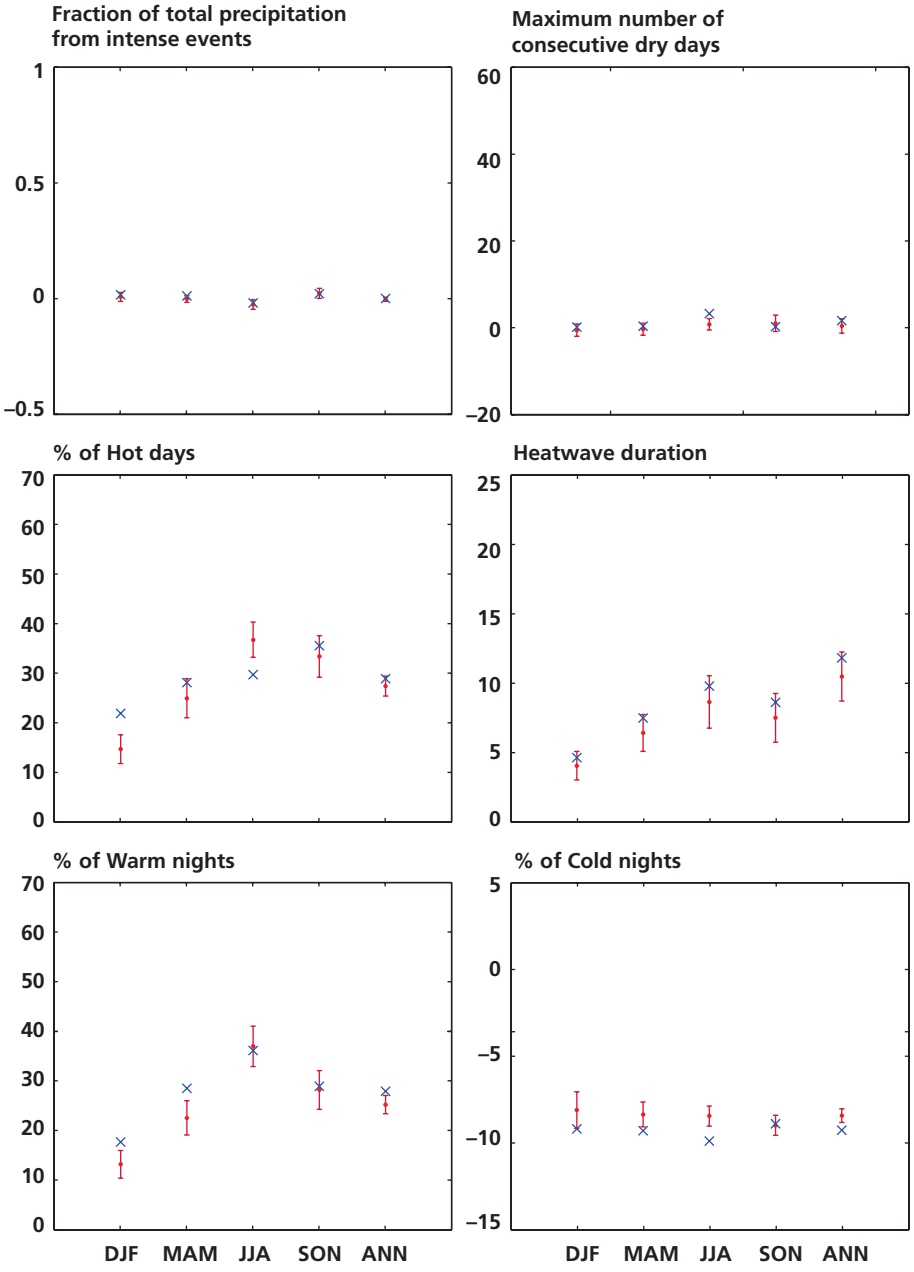

Figure 18(f): As Figure 18(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Valley

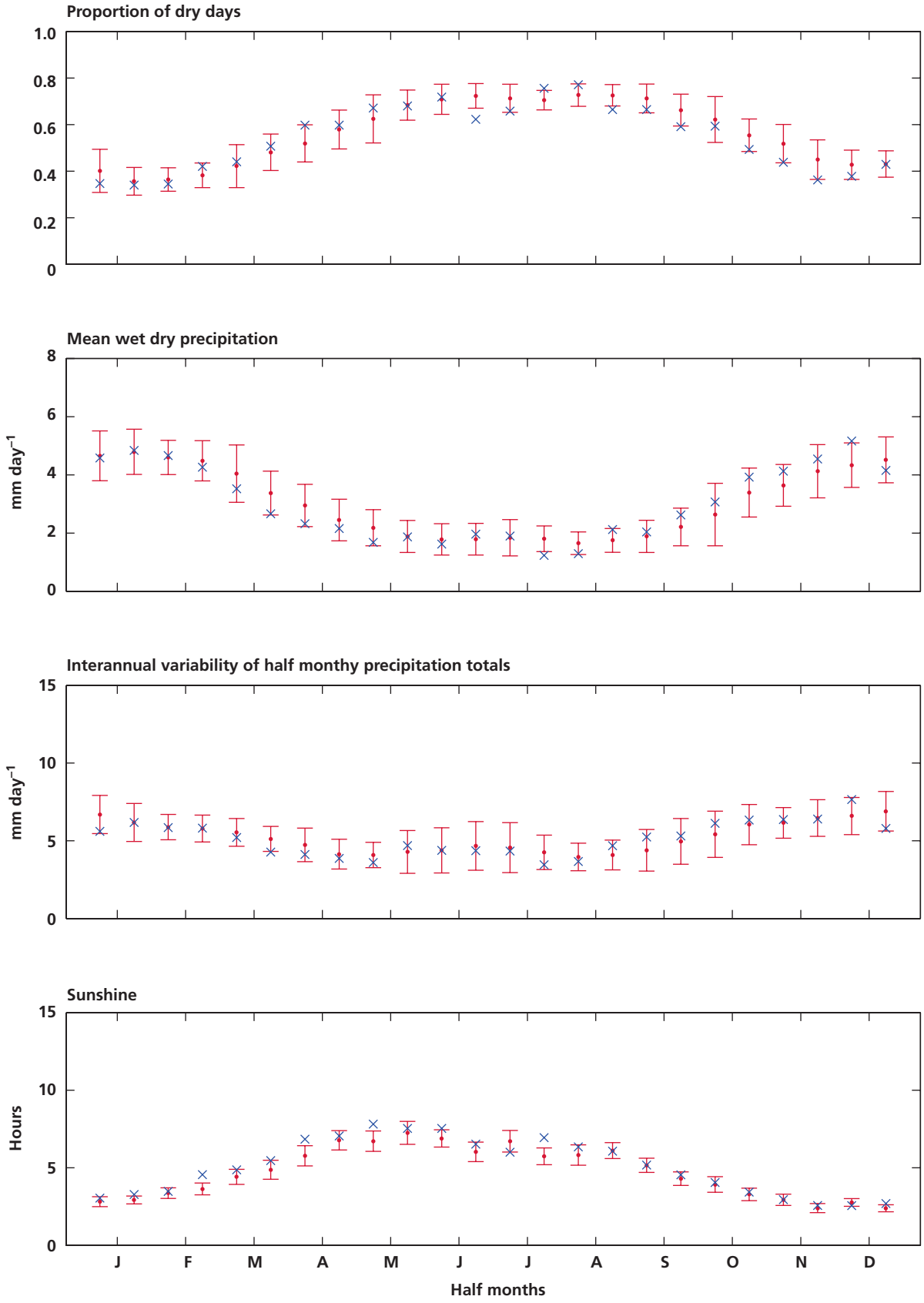

Figure 19(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Valley. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Valley

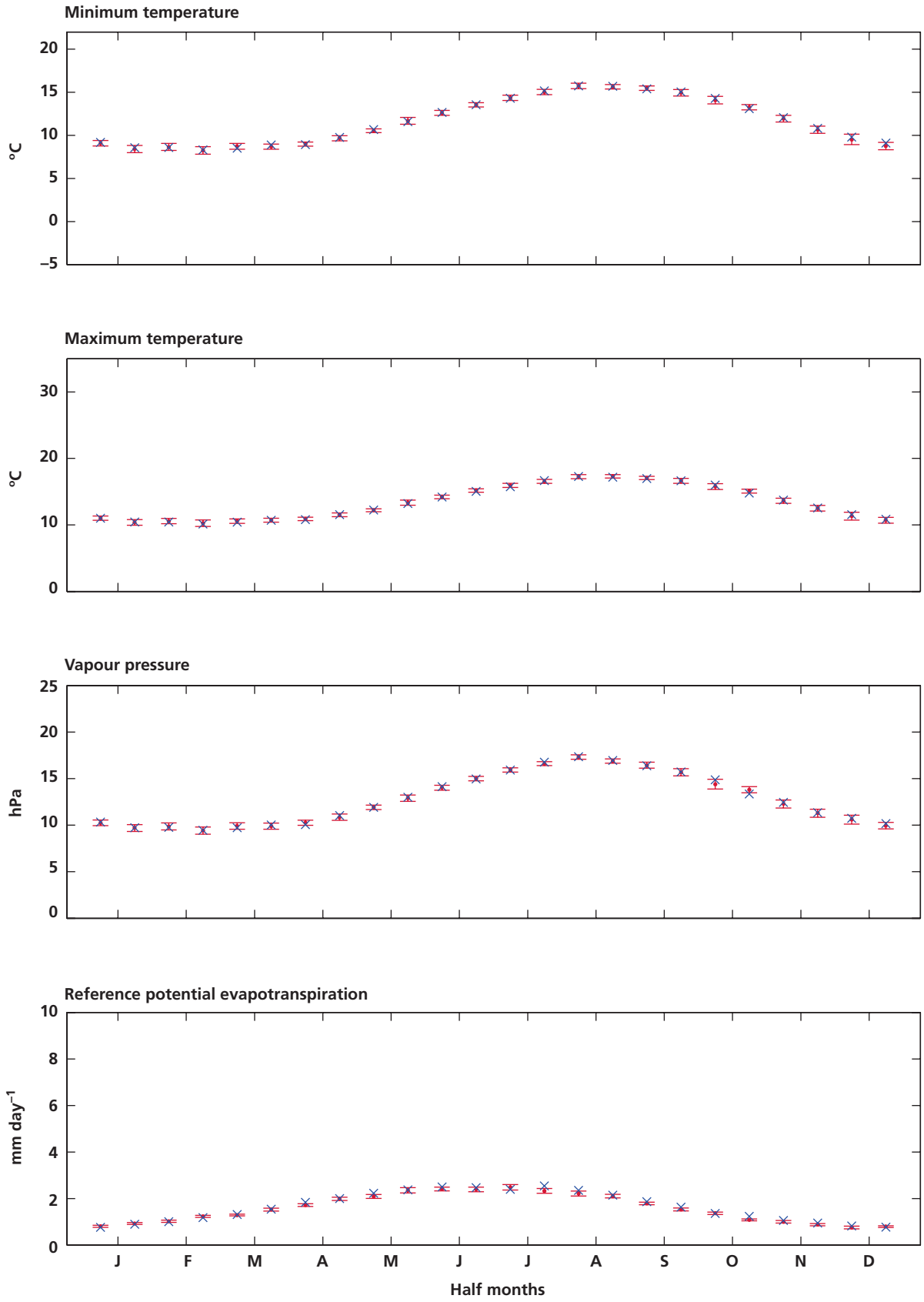

Figure 19(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Valley. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Valley

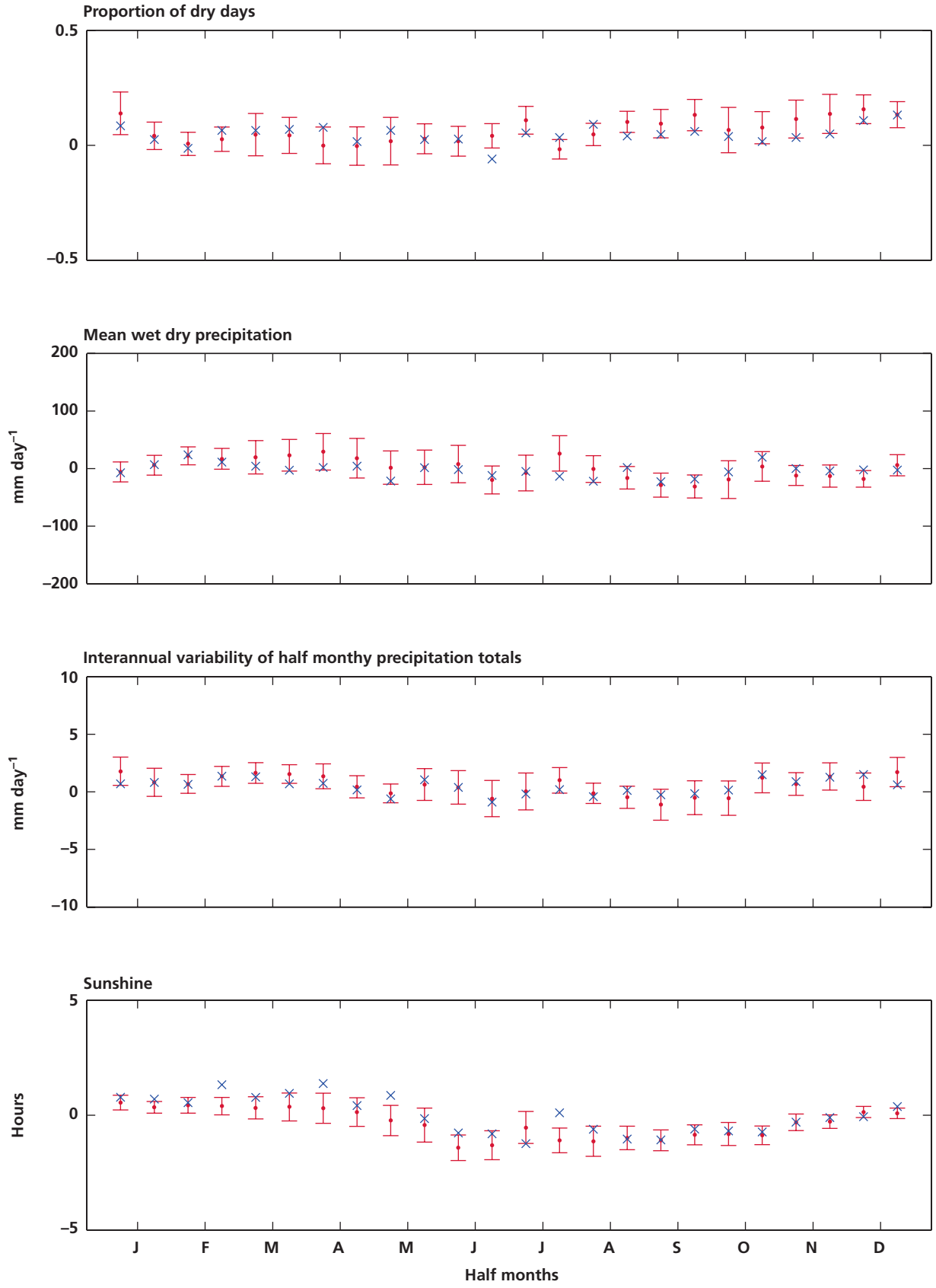

Figure 19(c): Figure 19(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Valley

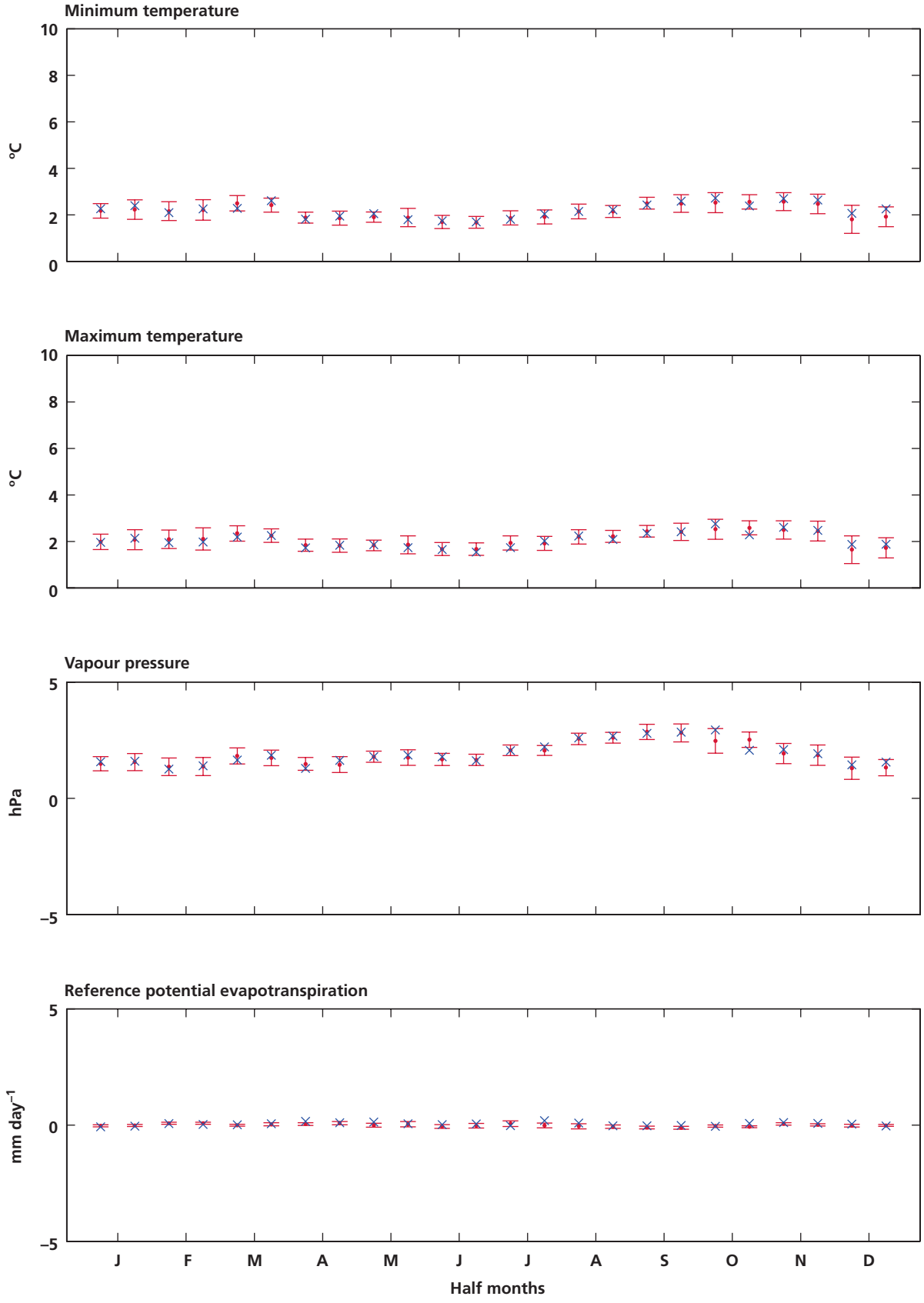

Figure 19(d): Figure 19(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Valley

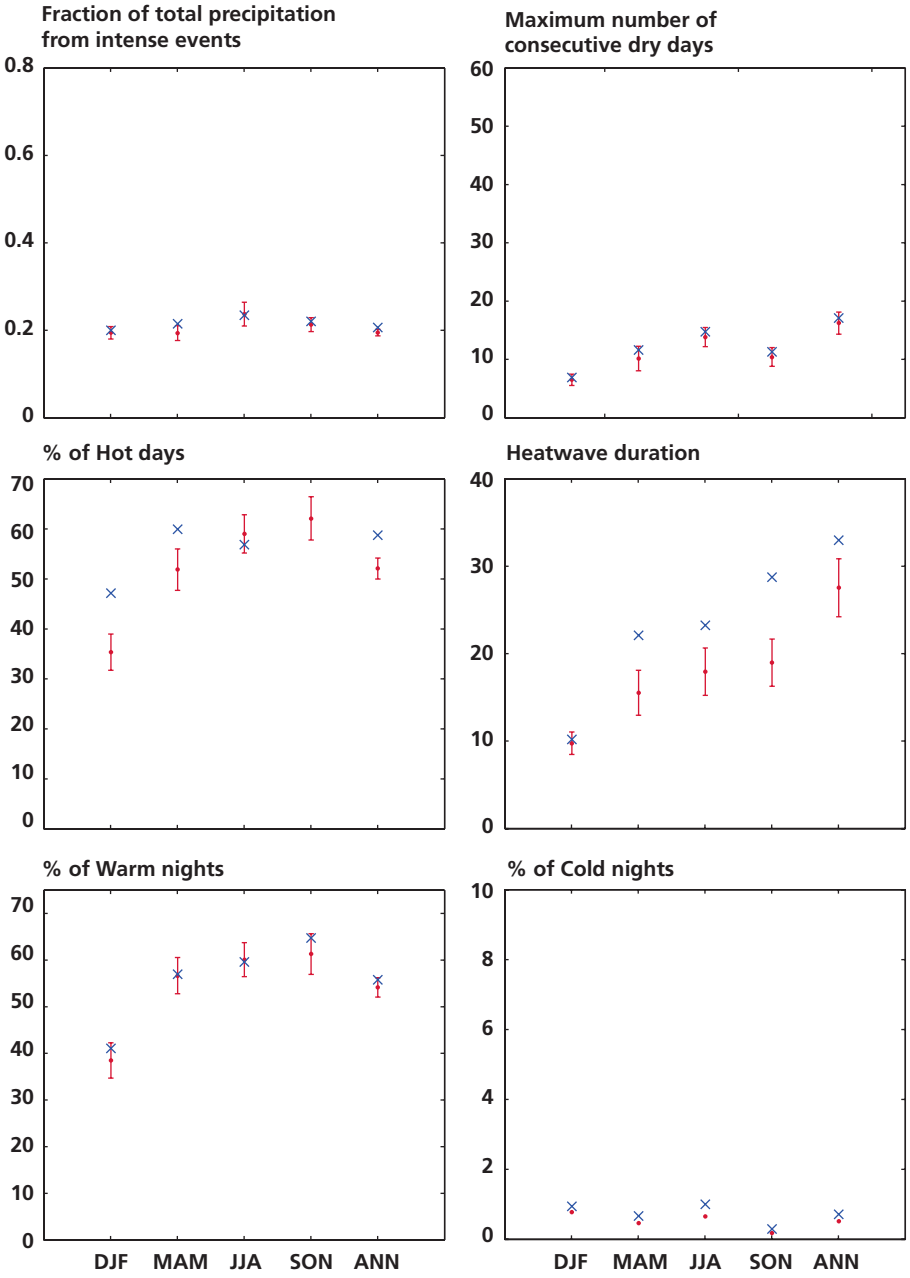

Figure 19(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Valley. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Valley

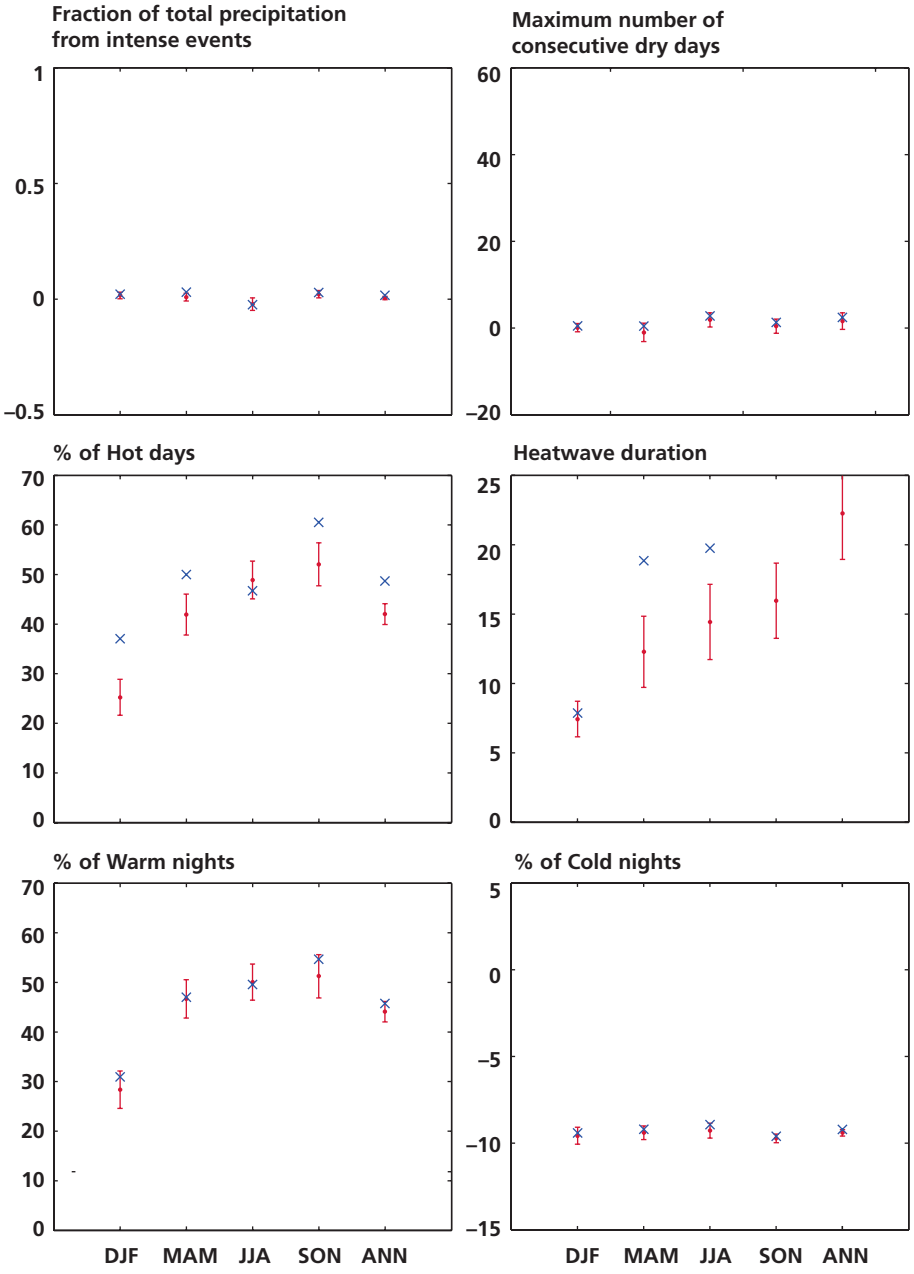

Figure 19(f): As Figure 19(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Wick

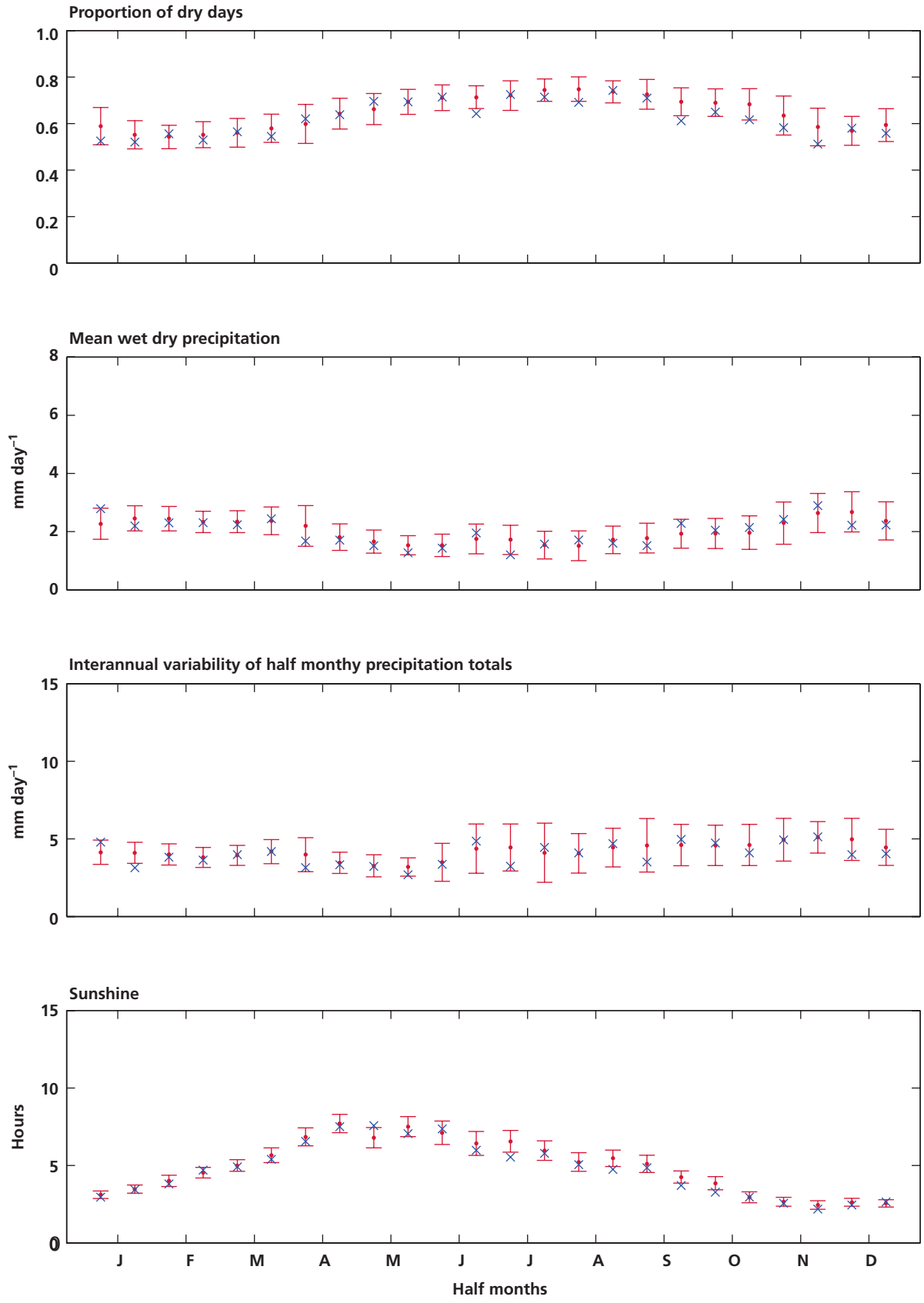

Figure 20(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Wick. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Wick

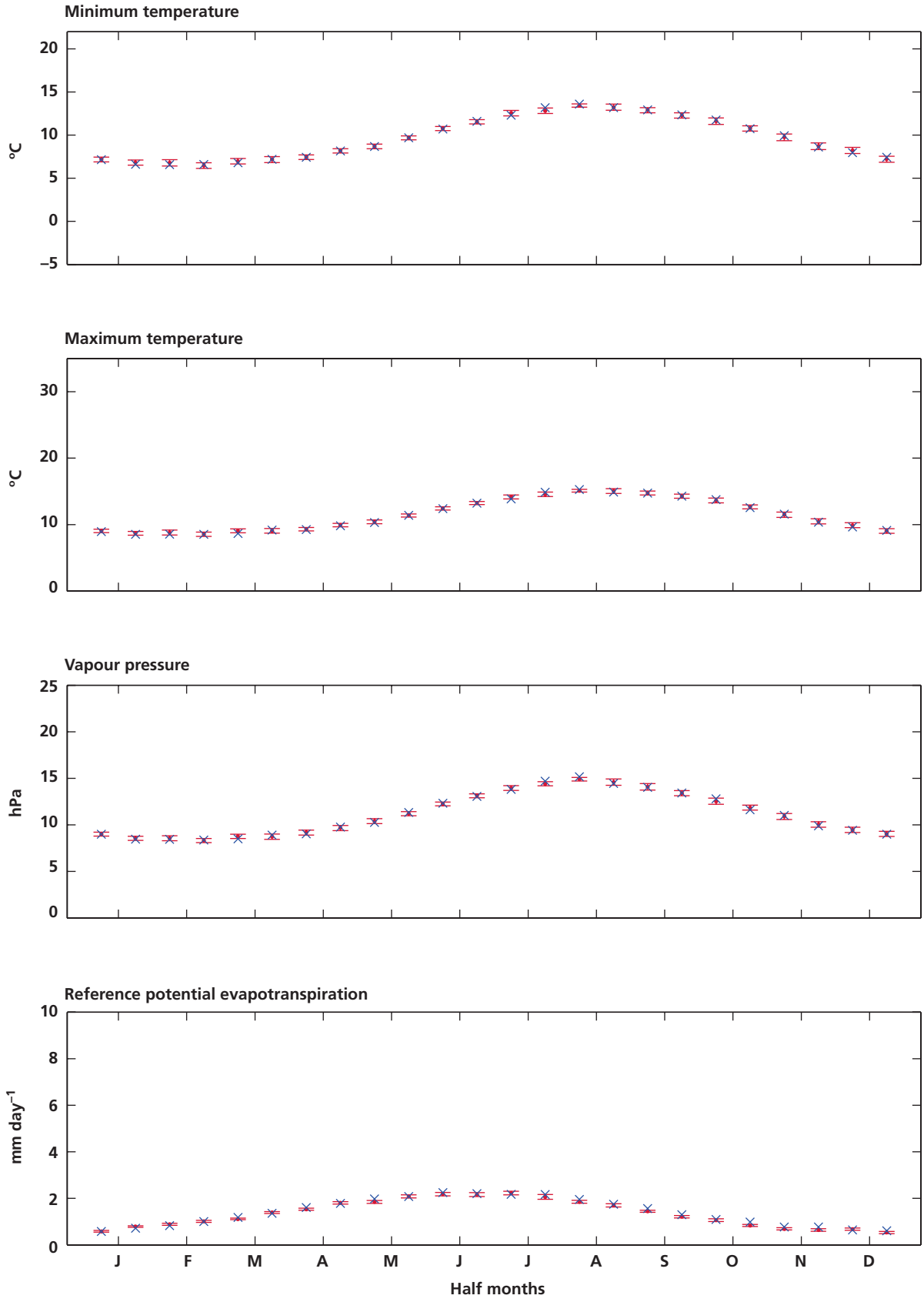

Figure 20(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Wick. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Wick

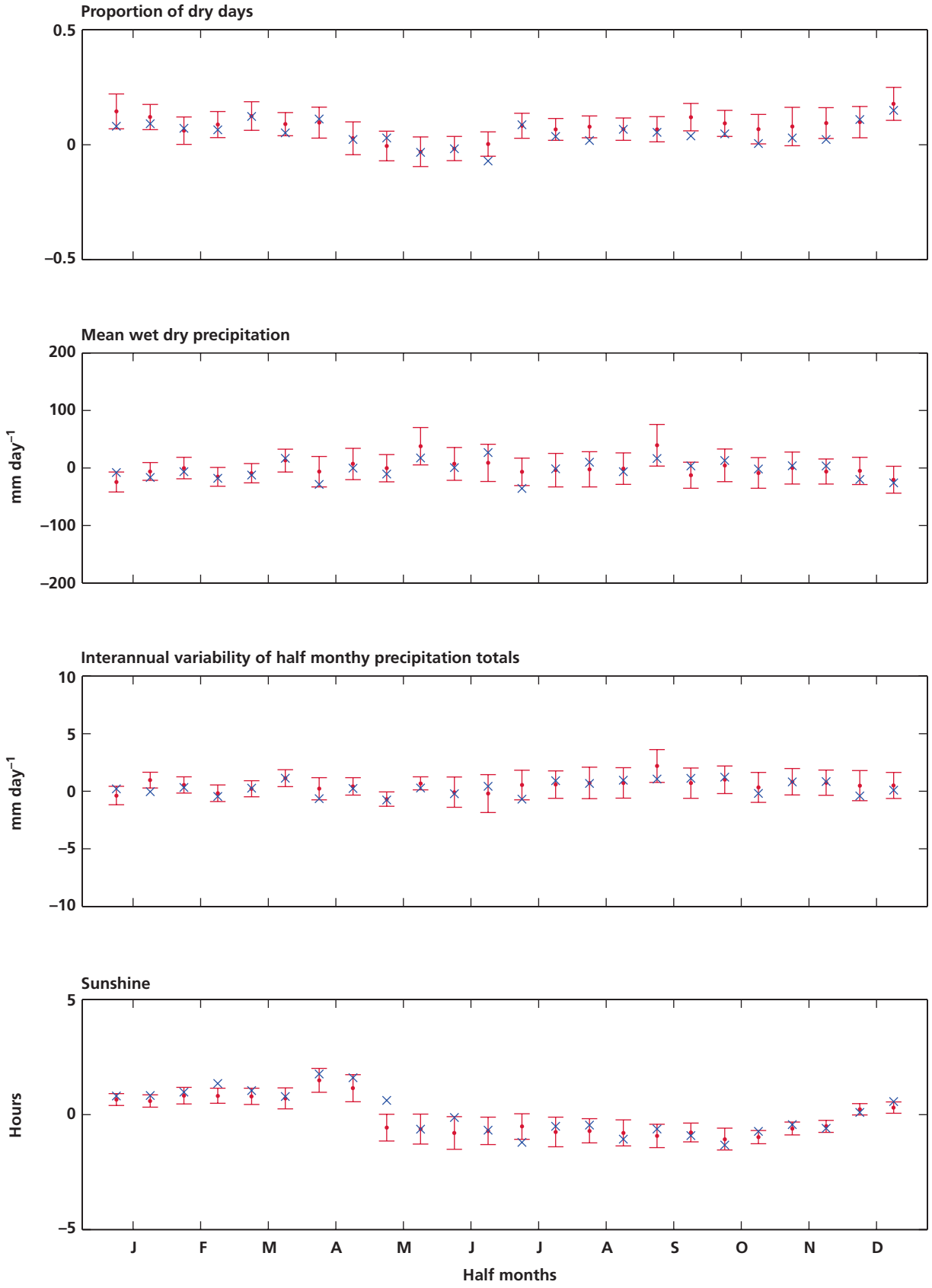

Figure 20(c): Figure 20(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Wick

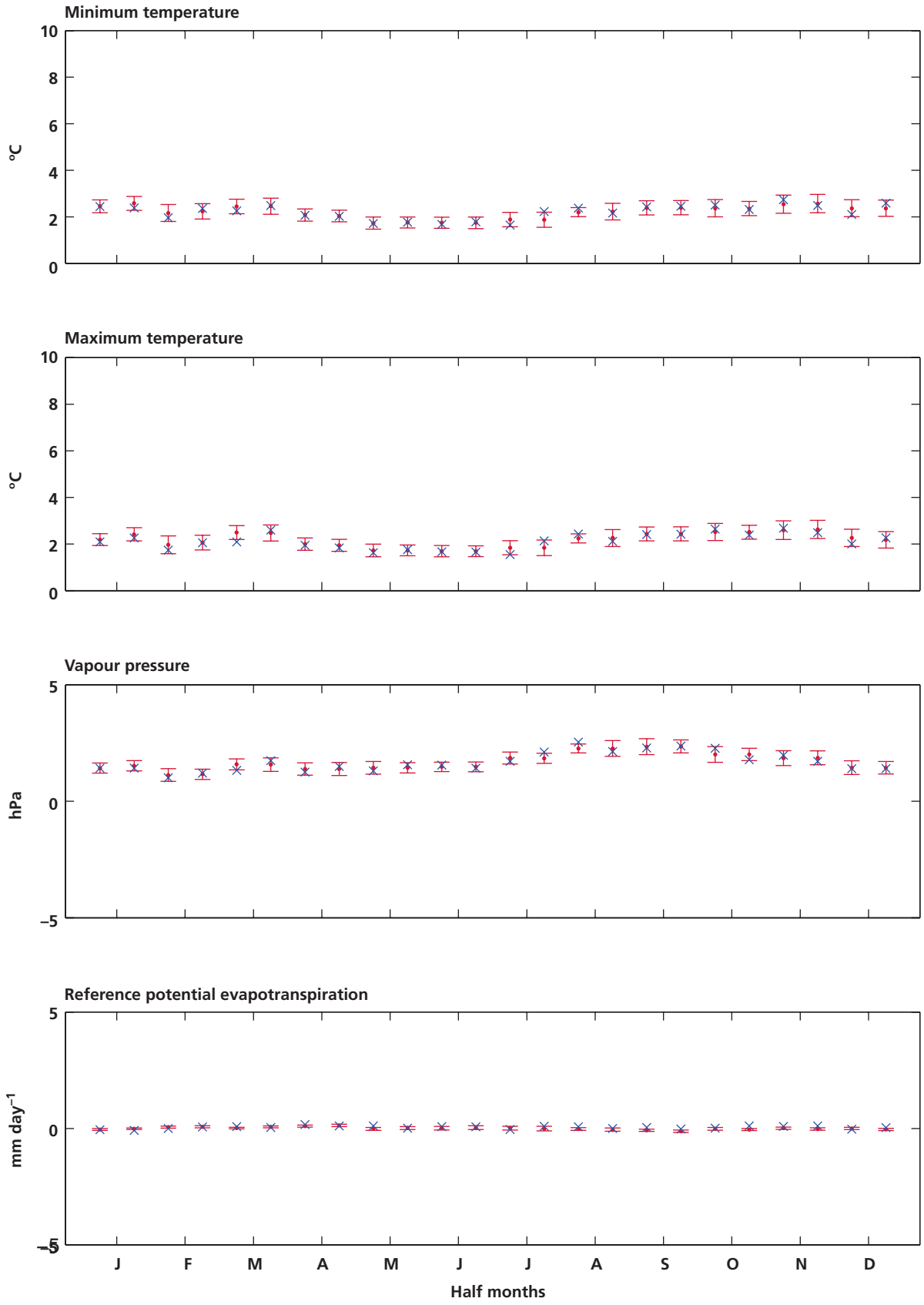

Figure 20(d): Figure 20(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Wick

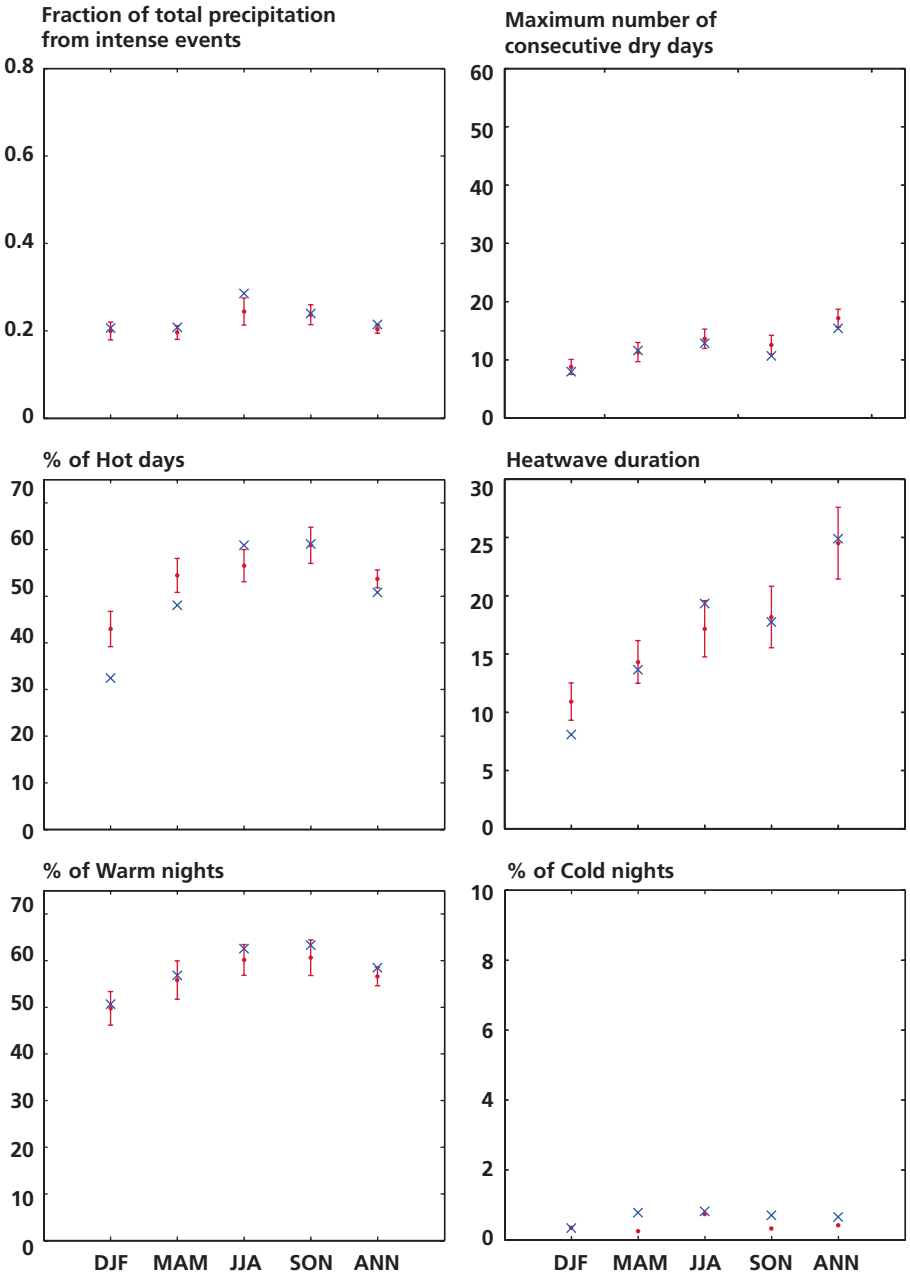

Figure 20(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Wick. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Wick

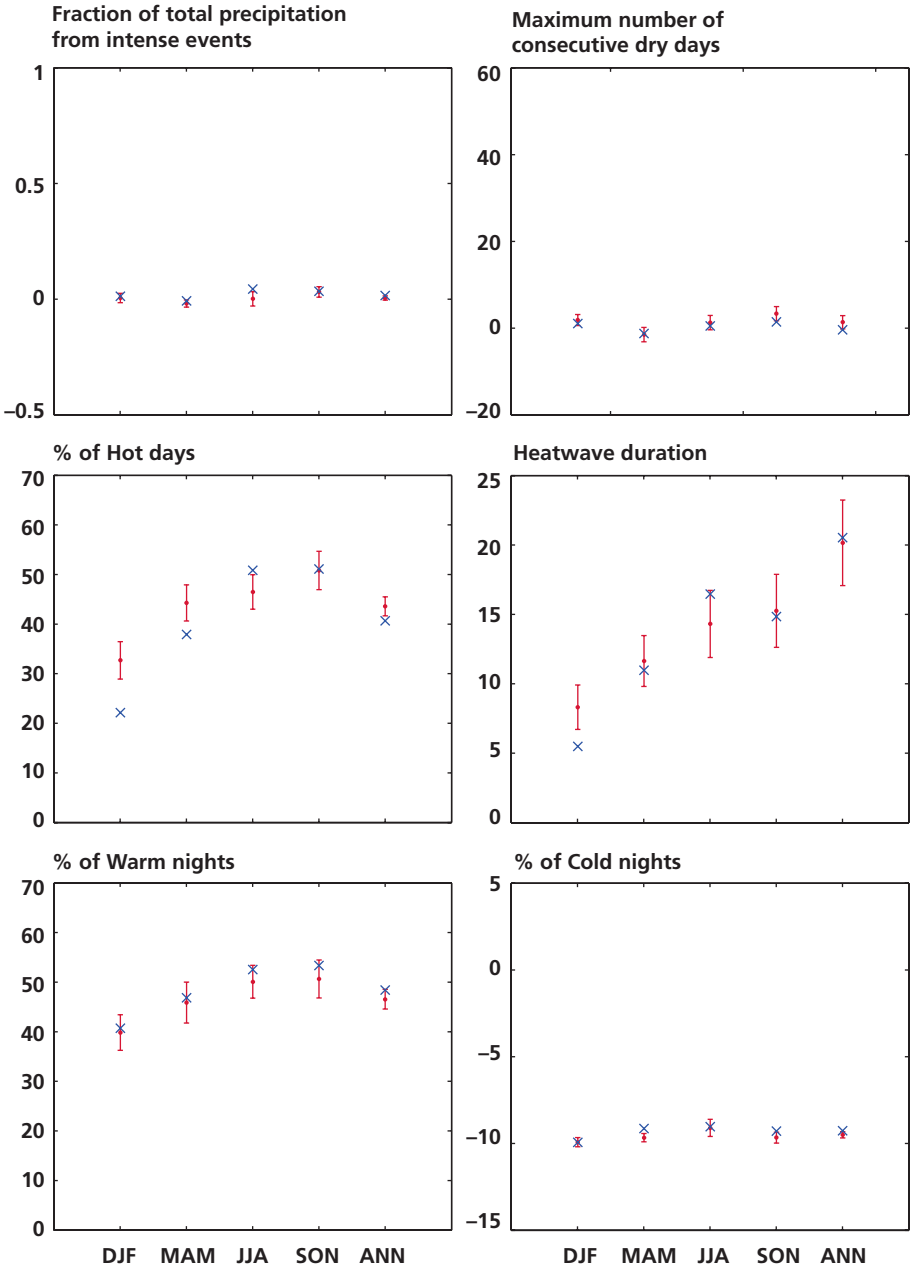

Figure 20(f): As Figure 20(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Yeovilton

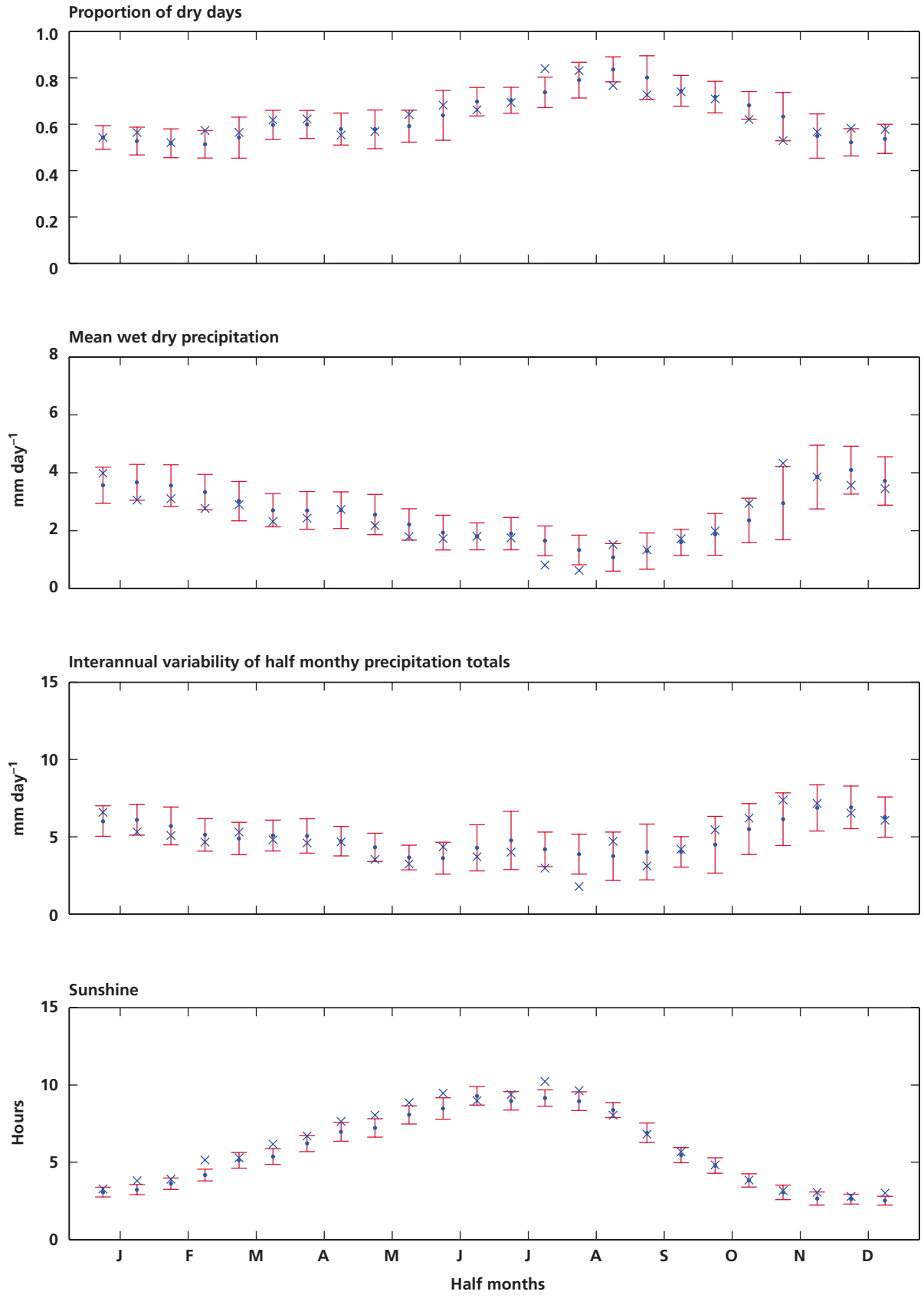

Figure 21(a): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Yeovilton. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Yeovilton

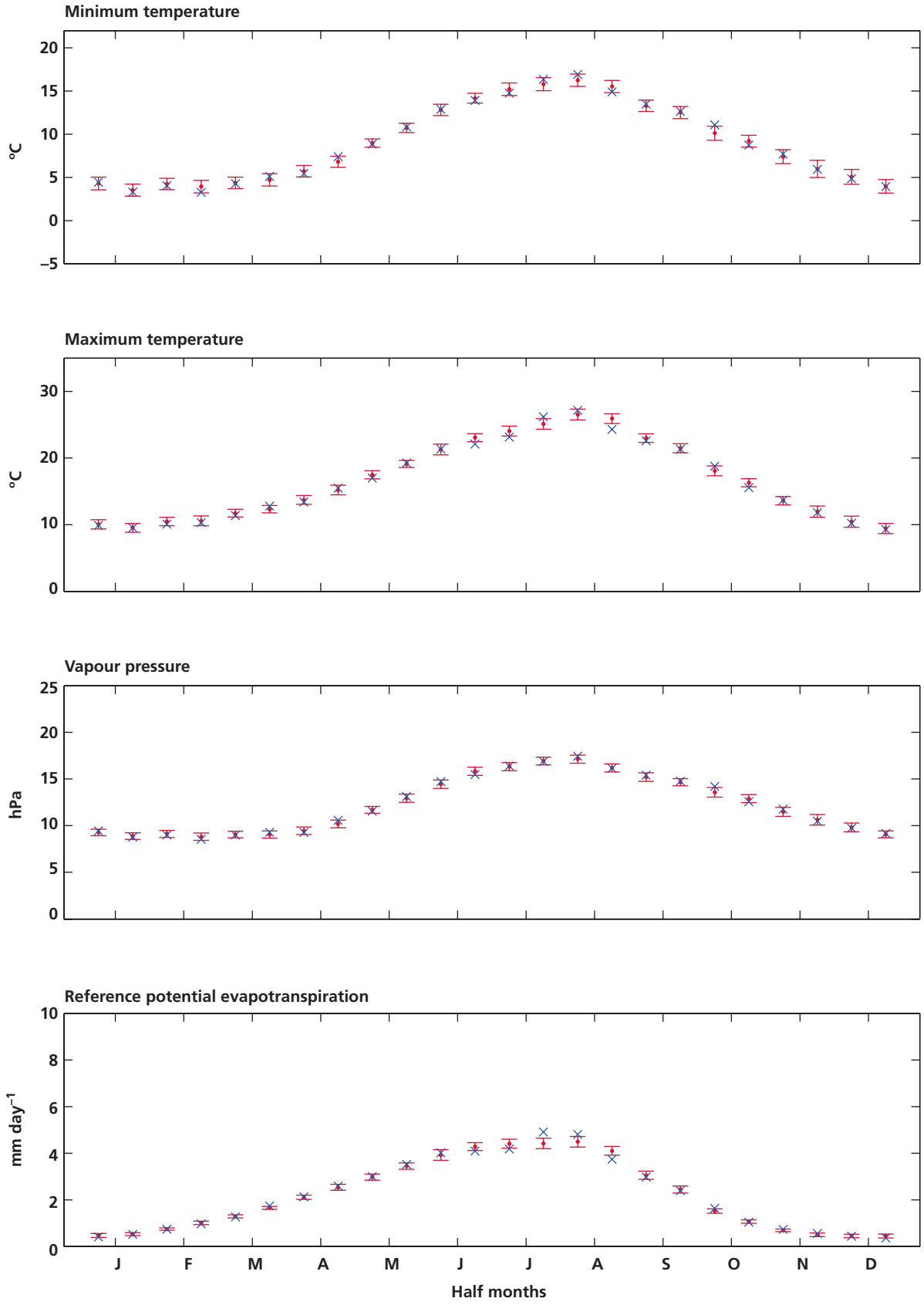

Figure 21(b): Base RCM simulation for the 2080s (shown as blue crosses) and WG simulated values for the 2080s (shown as red dots and error bars) for each half month for the 25 x 25 km grid box nearest Yeovilton. The WG was fit to the RCM output for 1961–1990 and then perturbed using Change Factors derived from the RCMs. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Yeovilton

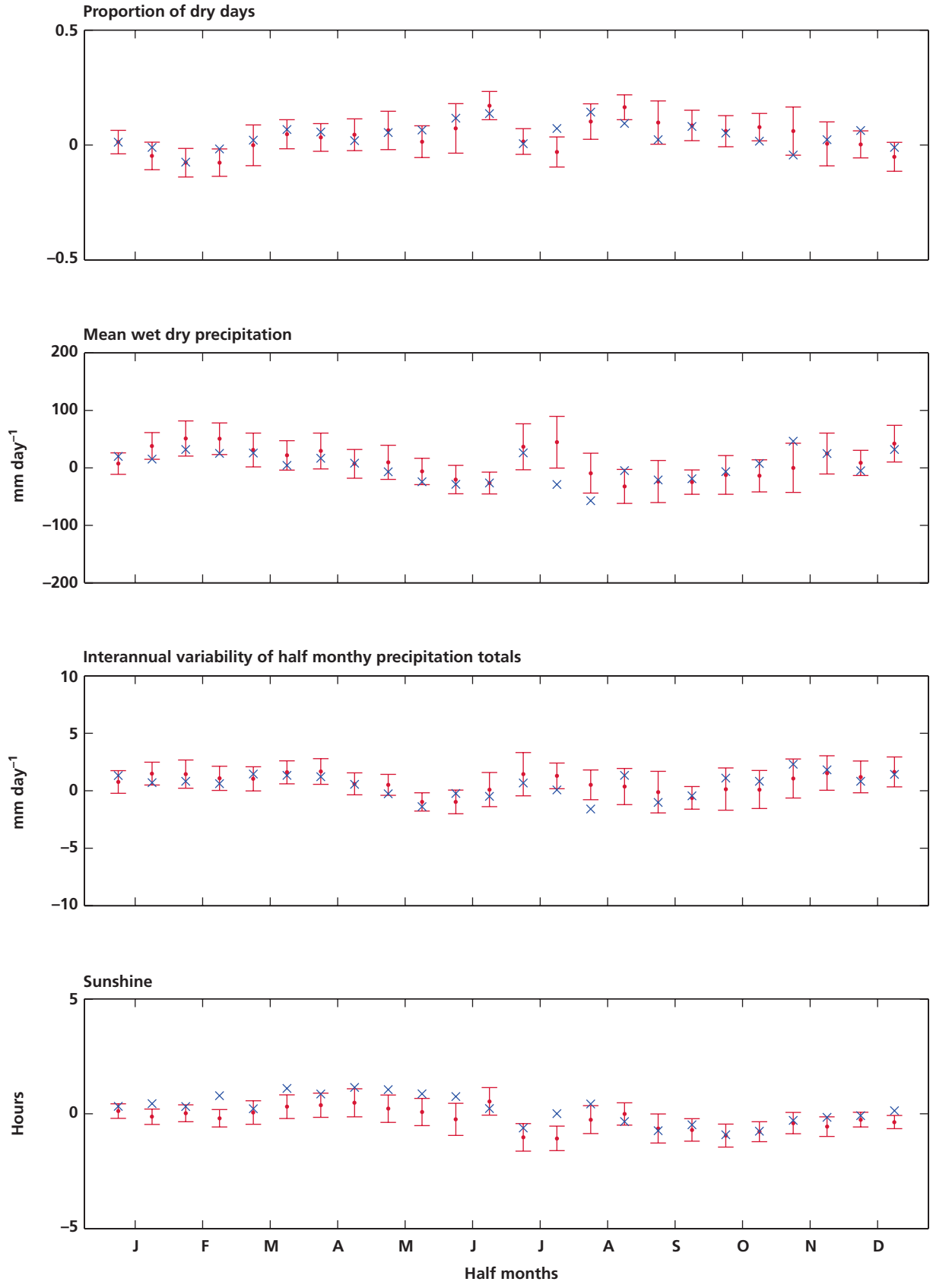

Figure 21(c): Figure 21(a) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Yeovilton

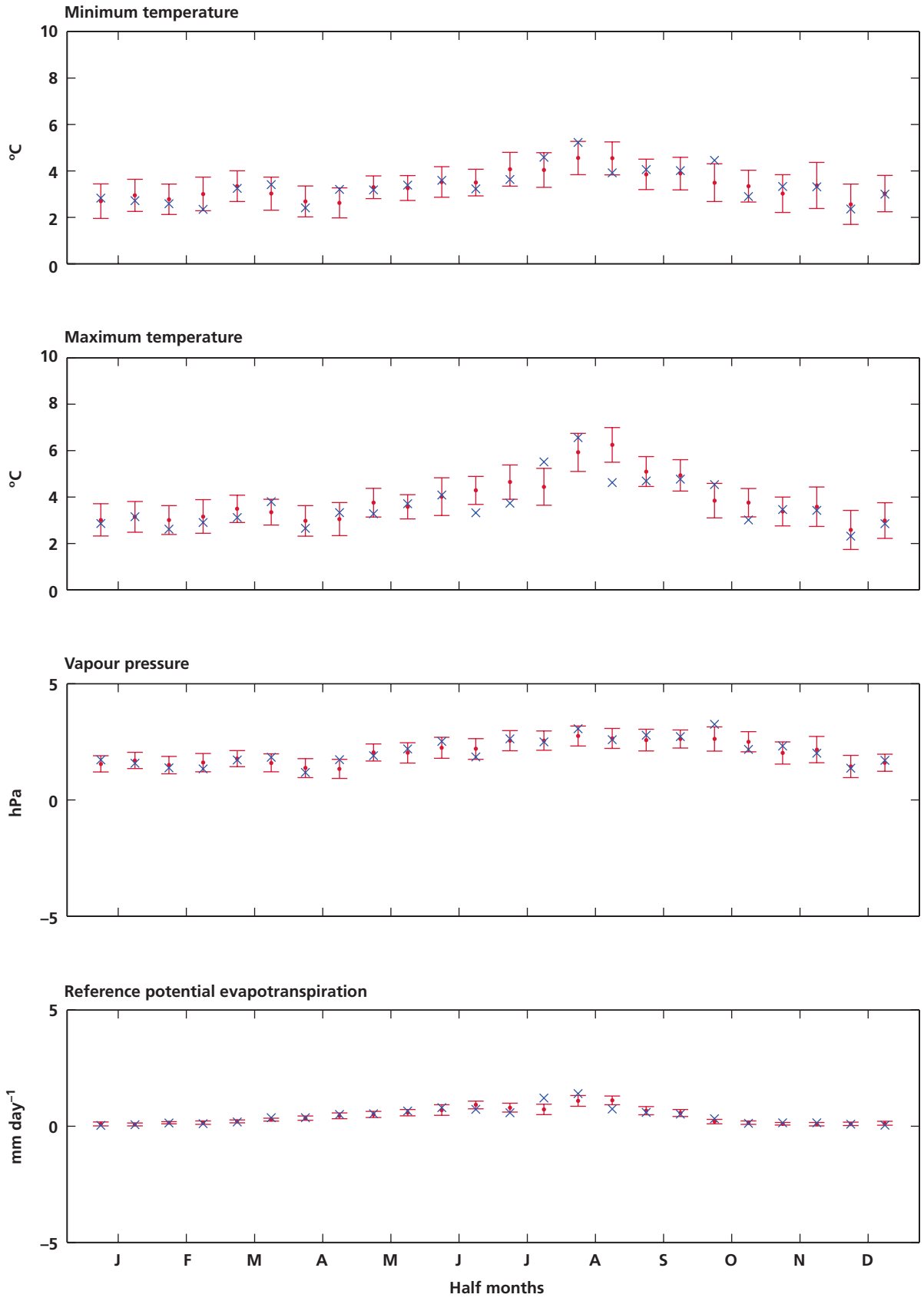

Figure 21(d): Figure 21(b) shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.

Yeovilton

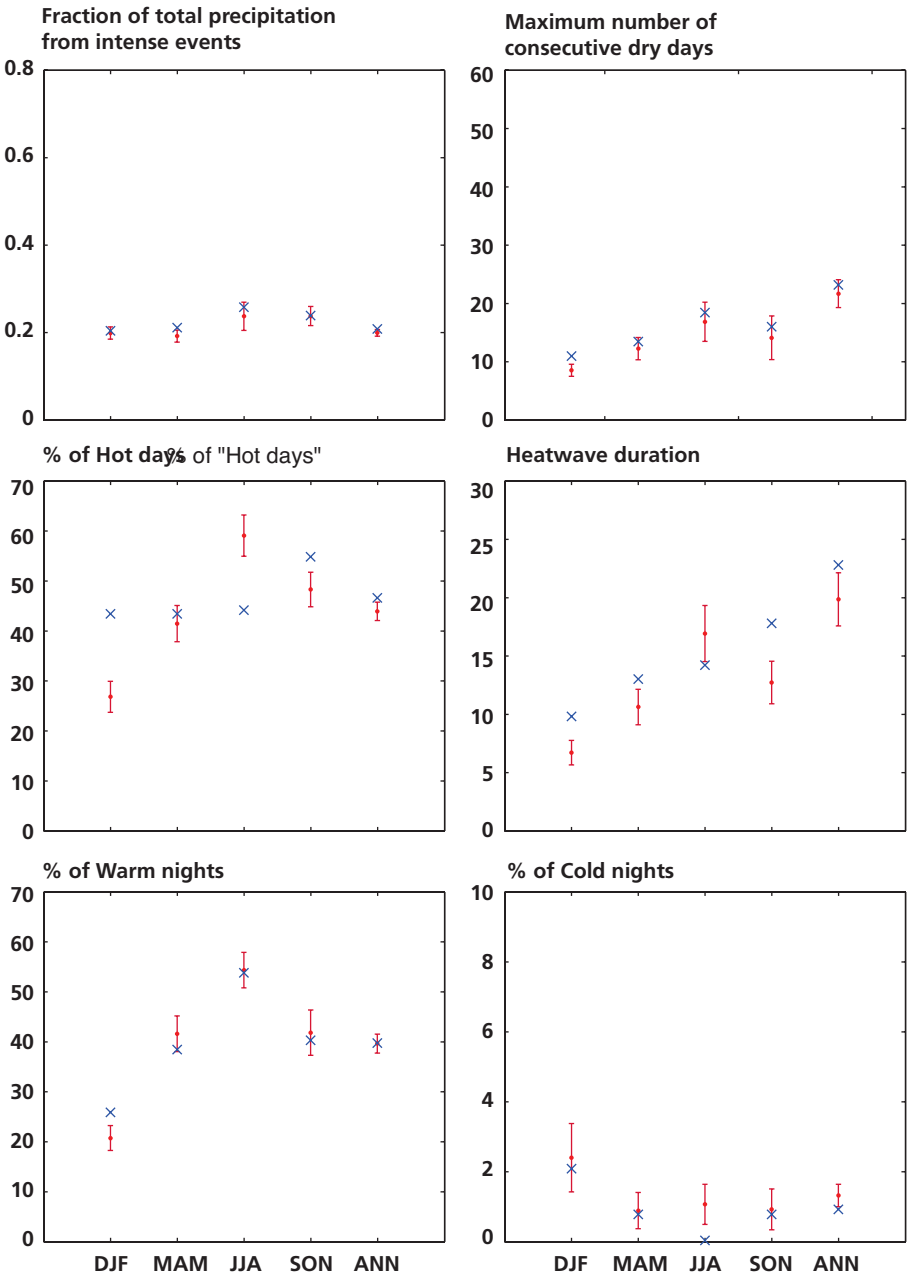

Figure 21(e): Seasonal and annual values from the base RCM 2080s simulation (shown as blue crosses) and from the WG simulated for the 2080s (shown as red dots and error bars) for the 25 x 25 km grid box nearest Yeovilton. The WG was fit to the RCM output for 1961–1990 and then perturbed with the Change Factors from the UKCP09 sampled data. The simulated values are the means (red dots) of 100 Weather Generator runs. The lines and bars show the variability of the 100 runs (plotted as plus/minus two standard deviations around the mean).

Yeovilton

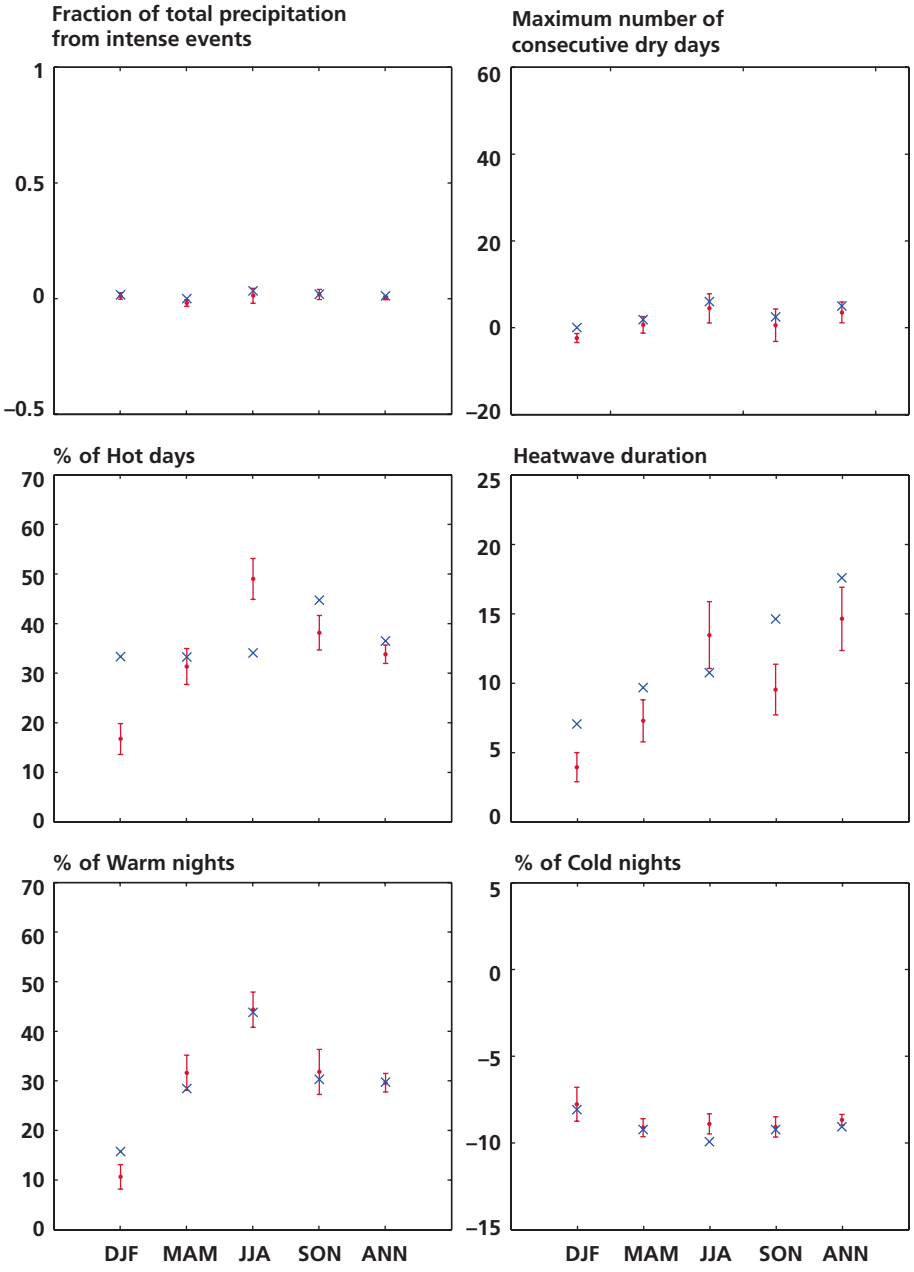

Figure 21(f): As Figure 21(e) but shown as differences (the climate change component) between the future and control simulations, from the WG in red and the RCM in blue.